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Original Communications

REDUCTION OF THE PREMATURE INFANT MORTALITY

THROUGH THE ESTIMATION OF FETAL WEIGHT IN UTERO AND AS A RESULT OF AN ANALYSIS OF THE INFLUENCE OF VARIOUS OBSTETRIC FACTORS UPON THE VIABILITY OF 958 PREMATURE INFANTS.

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IMPROVEMENT in the premature infant situation depends upon a reduction in the number of deaths that occur in the first forty-eight hours following delivery. The justification for this statement is found in the fact that over 80 per cent of the premature infant deaths occur in this period (Chart 1). The importance of the problem is evident when we consider that the premature infant, representing but 3 per cent of the total births, accounts for over 50 per cent of the neonatal deaths.

Blackfan, Yaglou, and Wyman[1] have demonstrated that the outlook for the premature infant *capable of surviving the first forty-eight-hour period* can be greatly improved through an application of the basic principles of "(a) stabilization of body temperature, (b) adequate and proper nutriment, (c) prophylaxis against infection, and (d) intelligent nursing and medical care." They found, however, that this method of treatment was unable to influence the death rate during the first forty-eight hours. These methods have been applied to our group of premature infants, who have the advantage of being placed in an air-conditioned nursery immediately after delivery without exposure

This is the fourth in a series of studies on the reduction of the newborn infant death rate from the Boston Lying-In Hospital, the Departments of Obstetrics and Pediatrics of the Harvard Medical School, and The Department of Child Hygiene of the Harvard School of Public Health.

Read before the American Pediatric Society, Asheville, N. C., May 4, 1934.

to chilling and infection, with like results. Our net mortality (deaths after the first forty-eight-hour period) was reduced but the death rate for the first two days was unaffected and for six consecutive years the gross mortality remained at the distressingly high level of 35 per cent.

The inability of existing methods to improve the condition of the premature infant beyond the present point led to a study of the fetus in utero and during delivery with particular reference to factors influencing its viability. From this investigation two possible approaches to the problem of reducing the premature infant mortality have been developed. The first is an attempt to increase the average

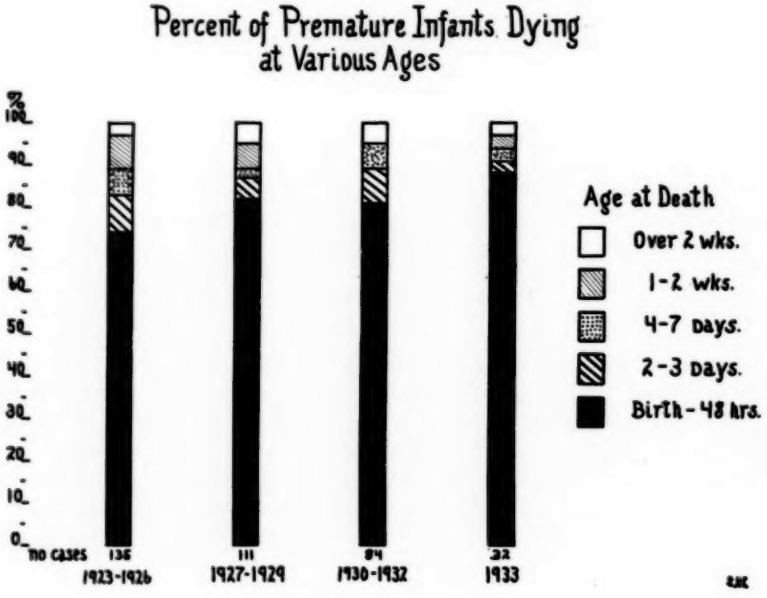

Chart 1.

weight of the premature infant at birth through a method for the estimation of fetal weight in utero.[2] The second is an attempt to discover the safest method for the obstetric management of premature labors through an analysis of the influence of various factors upon the viability of 958 premature infants.

AN ATTEMPT TO INCREASE THE WEIGHT OF THE PREMATURE INFANT AT BIRTH

The actual weight of the premature infant* at birth is the most important single factor influencing its viability. With each 8-ounce

*In this study a *premature infant* is defined as any infant born alive, even though it live only a few minutes, weighing from 0 to 5 pounds. An *immature infant* is defined as one weighing from 5 to 6 pounds at birth.

increment in birth weight there is a marked reduction in the premature infant mortality (Chart 2). Evidence has been obtained suggesting that the weekly gain of the fetus in utero is 4 ounces during the seventh lunar month, 6 ounces during the eighth, and from 8 to 12 ounces per week during the ninth month. Taking these figures as the index of the increment in growth of the fetus in utero the beneficial effect of even one week's delay in the induction of labor or in the delivery by cesarean section becomes apparent.

The ability to select the ideal moment for the elective termination of pregnancy depends upon the possession of reliable information

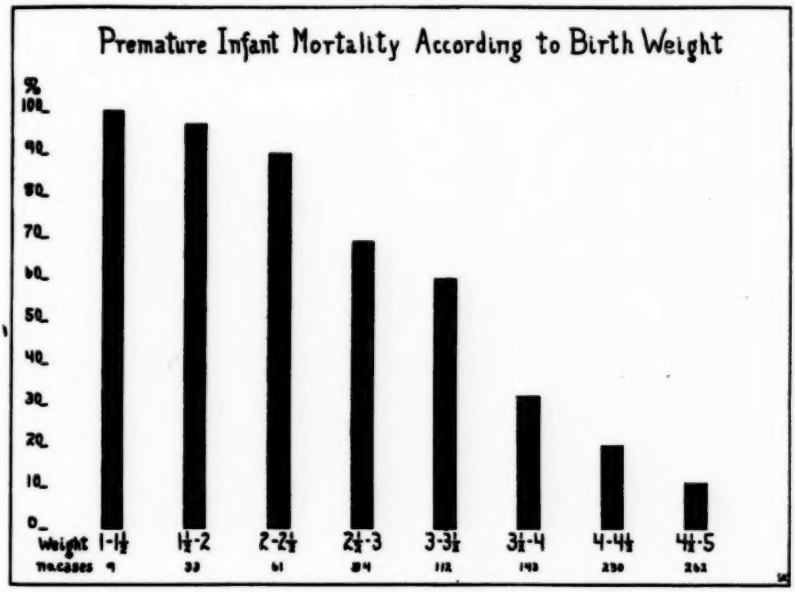

Chart 2.

concerning the size of the fetus prior to delivery. Inasmuch as the fundamental work of Scammon and Calkins[3] has established that the occipitofrontal diameter of the fetal head is an index of its maturity, it seemed obvious that if this measurement could be determined in utero, it would be possible to determine the age of the fetus at any period of intrauterine life.

A modified roentgenometric technic has been developed[2] whereby the occipitofrontal diameter of the fetal head in utero can be accurately measured. From this measurement the fetal age can be obtained by comparison with Scammon's data. In a study of over

600 newborn infants the relationship that exists between the occipitofrontal diameter and the birth weight has been established (Chart 3). It is therefore possible to predict the age and weight of the fetus in utero from an x-ray determination of its occipitofrontal diameter.

The opportunity to control the time at which pregnancy shall be terminated has been found to be present in 50 per cent of the cases,

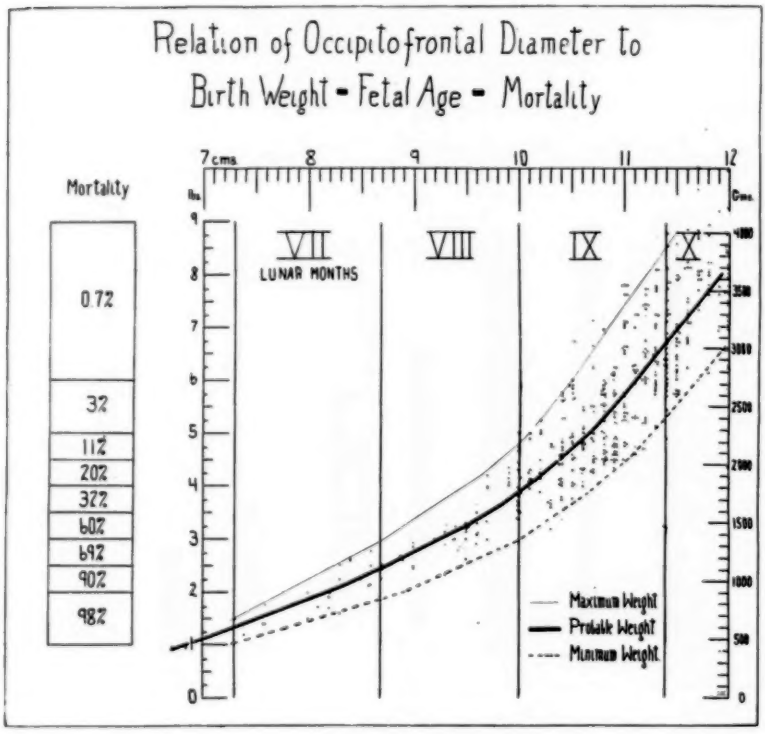

Chart 3.

since toxemia, heart disease, vaginal bleeding, diabetes mellitus, pyelitis, and pulmonary disease account for this proportion of the premature infants delivered. Toxemia alone was found to be responsible for 28 per cent of the premature infants born during the past eleven years. In the presence of the more severe grades of toxemia the safety of the fetus demands termination of pregnancy when an infant of adequate size can be assured, for further delay in the induction of labor may result in an intrauterine death. Evidence has been obtained suggesting that the risk of stillbirth is proportional to the

height of the maternal blood pressure.[4] The decision as to the time for the induction of labor in the presence of toxemia depends, therefore, upon a consideration of the chances of the fetus as a premature infant as opposed to its chances of being stillborn.

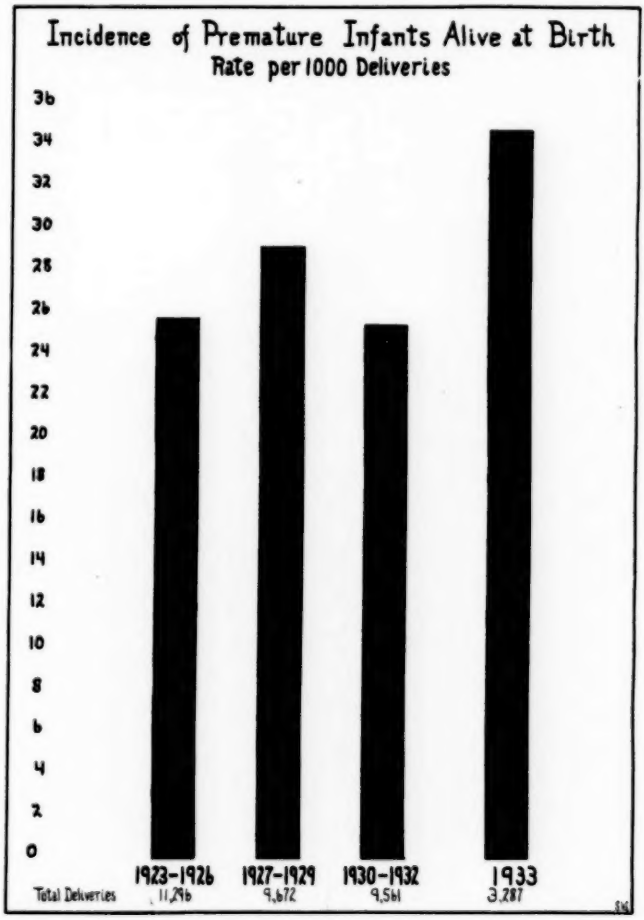

Chart 4.

Through the application of this method for the x-ray determination of fetal size to over 240 pregnant women during 1933, the incidence of premature infants alive at birth increased from an average of 27.6 for the preceding ten years to 34.7 per 1,000 deliveries (Chart 4). Furthermore, the stillbirth rate* was reduced from a level of 69 per 1,000

*The stillbirth rate includes miscarriages and premature nonviable infants.

deliveries for the preceding ten years to 47 per 1,000 in 1933 (Chart 5). The number of infants in the 4- to 5-pound group increased from an average of 52 per cent for the preceding ten years to 61 per cent

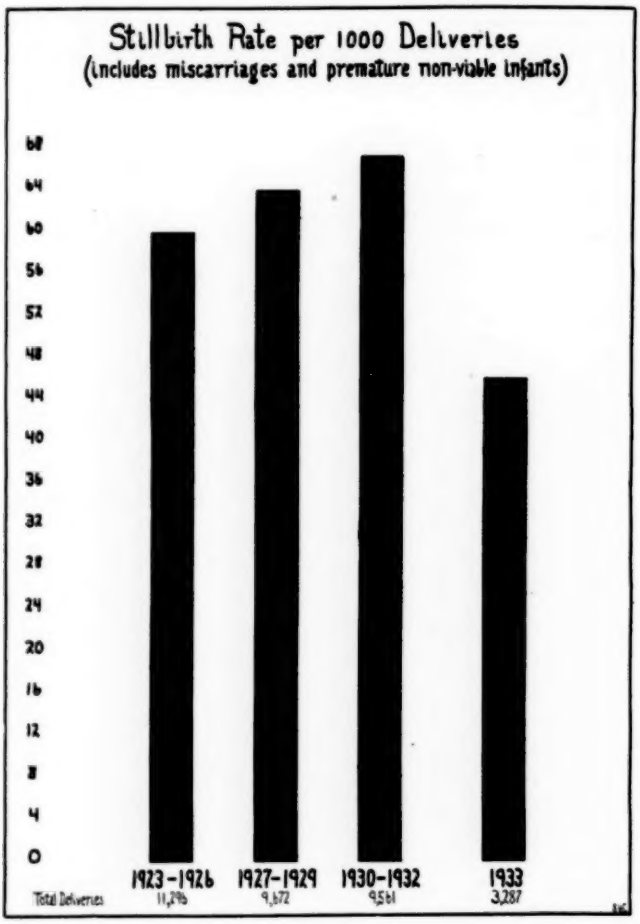

Chart 5.

for 1933. Finally, the premature infant gross mortality dropped for the first time in five years from 35 per cent to 29 per cent (Chart 6).

In addition to the determination of fetal maturity, it was found that there were two important influences that had effect during 1933, both of which have contributed to the improvements recorded. The

general use of pentobarbital and scopolamine analgesia during labor has resulted in a reduction in the incidence of operative deliveries from 44.6 per cent to 35.6 per cent.[5] With the mother relieved of pain, labor was allowed to pursue its natural course through full

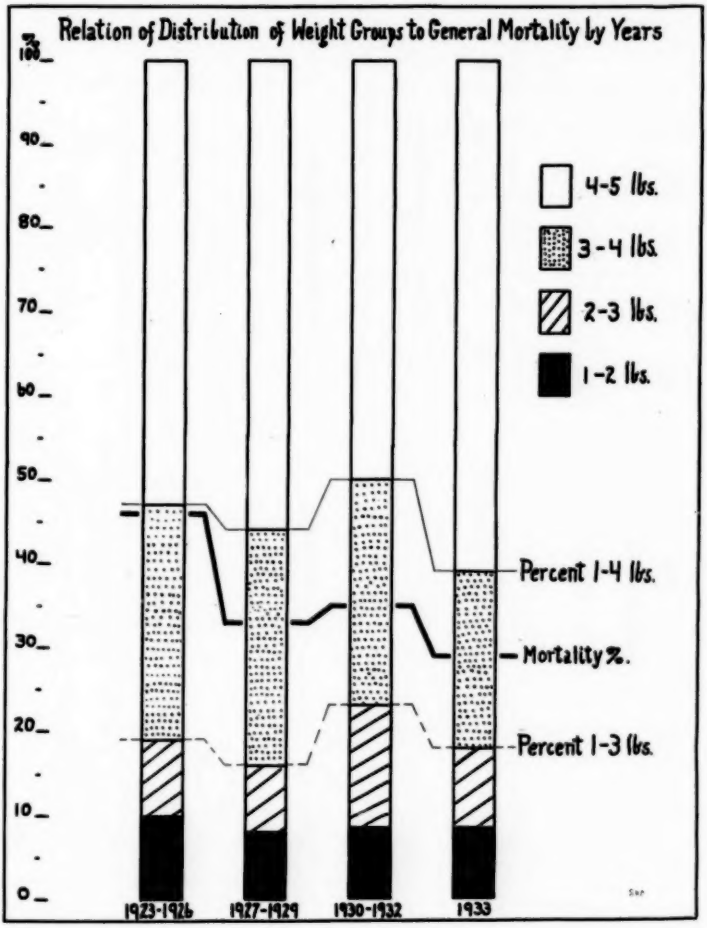

Chart 6.

dilatation of the cervix to normal delivery. Second, there has been a better understanding of the influence on the viability of the premature infant of (a) the maternal complication of pregnancy, (b) the method of delivery, and (c) the maternal administration of morphine during labor.

AN ANALYSIS OF THE INFLUENCE OF OBSTETRIC FACTORS UPON THE VIABILITY OF 958 PREMATURE INFANTS*

A. *The influence of the maternal complication of pregnancy* upon the mortality of comparable groups of premature infants is presented in Chart 7. Heart disease with failure and placenta previa are seen

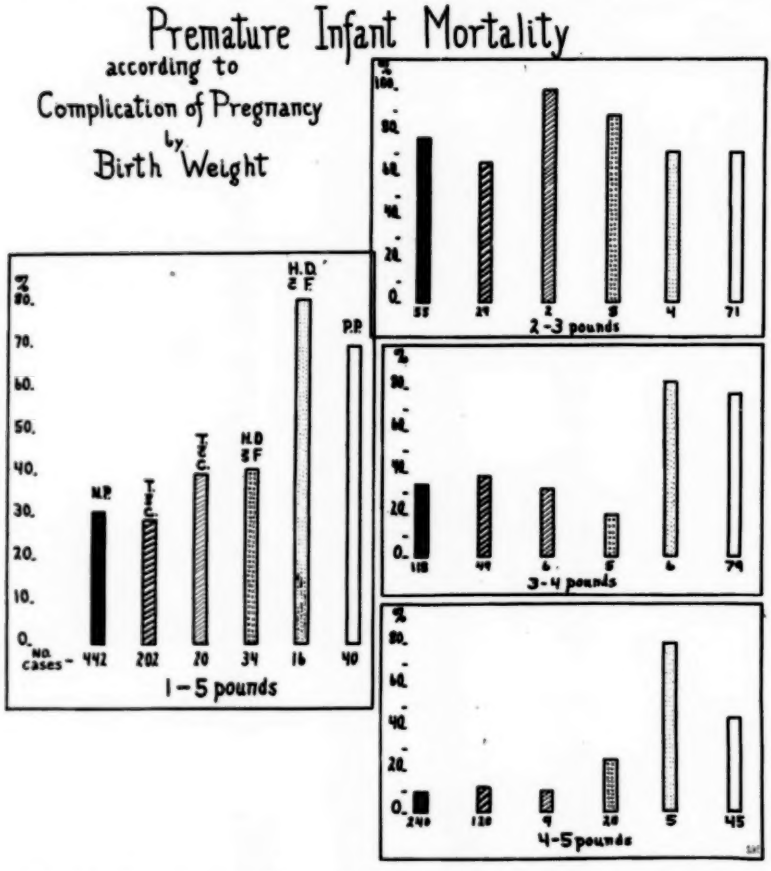

Chart 7.—Premature infant mortality; *N.P.*, normal pregnancy; *T. s C.*, toxemia without convulsions; *T. c C.*, toxemia with convulsions; *H.D. s F.*, heart disease without failure; *H.D. c F.*, heart disease with failure; *P.P.*, placenta previa.

to be the most dangerous complications of pregnancy from the point of view of the premature infant. The mortality of 70 per cent encountered in placenta previa is probably due to the fetal anoxemia

*A code system was used in this study with punched statistical cards and the tabulating machine. All the mortality statistics represent the gross, uncorrected figures. I am greatly indebted to Dr. Carl R. Doering and Mrs. James Bannon of the Vital Statistics Department of the Harvard School of Public Health for their assistance in making this study possible.

resulting from placental hemorrhage and the fact that the safety of the mother usually demands delivery either by cesarean section (50 per cent mortality) or by version and extraction (75 per cent mortality). The death rate of 80 per cent in heart disease with failure would seem to be due to the necessity of delivering these cases by

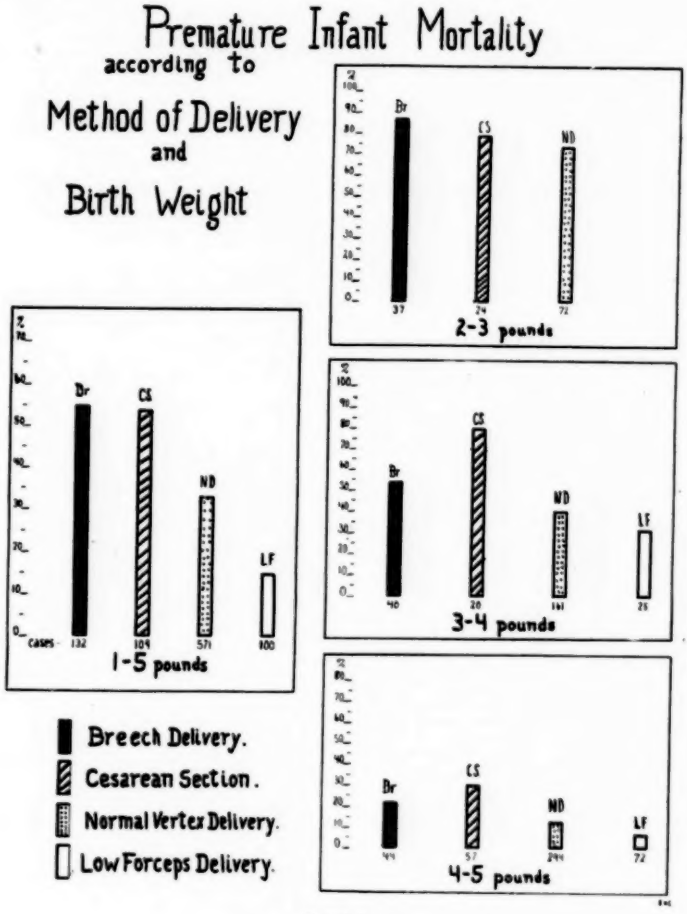

Chart 8.

cesarean section, the fact that 73 per cent of the mothers received morphine prior to delivery, and the fact that very probably the placental circulation was involved in the general circulatory failure.

The death hazard in heart disease without failure is only one-half of that with failure; this would seem to be due to the fact that only one-third of the cases are delivered by cesarean section, fewer have

received morphine and, of most importance, the factor of a failing placental circulation is absent.

The presence of toxemia in the mother, providing it does not kill the fetus in utero, apparently exerts no unfavorable influence upon the viability of a premature infant during the neonatal period. In the 3- to 5-pound weight groups the infants of mothers with uncompli-

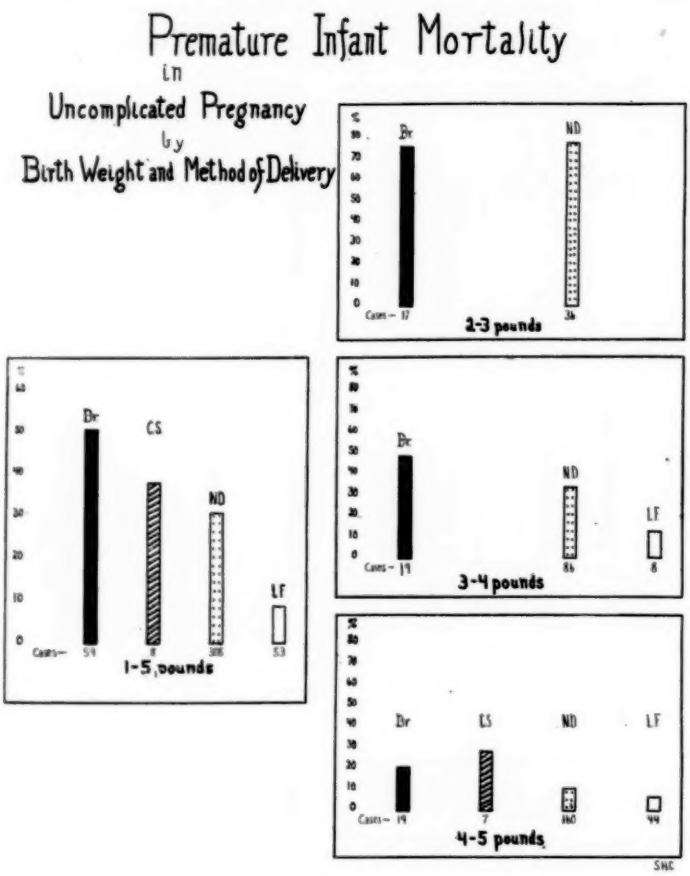

Chart 9.

cated pregnancies, of those with toxemia without convulsions, and even of those with eclampsia, all shared the same mortality rate.

The viability of the fetus does not appear to be directly affected by the complication of pregnancy present in the mother. It is indirectly affected by what the complication does to the placental circulation and by the method of obstetric management instituted.

B. *The influence of the method of delivery* upon the mortality of comparable weight groups of premature infants is demonstrated in Chart 8. Cesarean section and breech extraction appear to be the most dangerous methods for the delivery of a premature infant, whether we consider the infants as a whole or in comparable weight groups. The general mortality of 55 per cent for premature infants

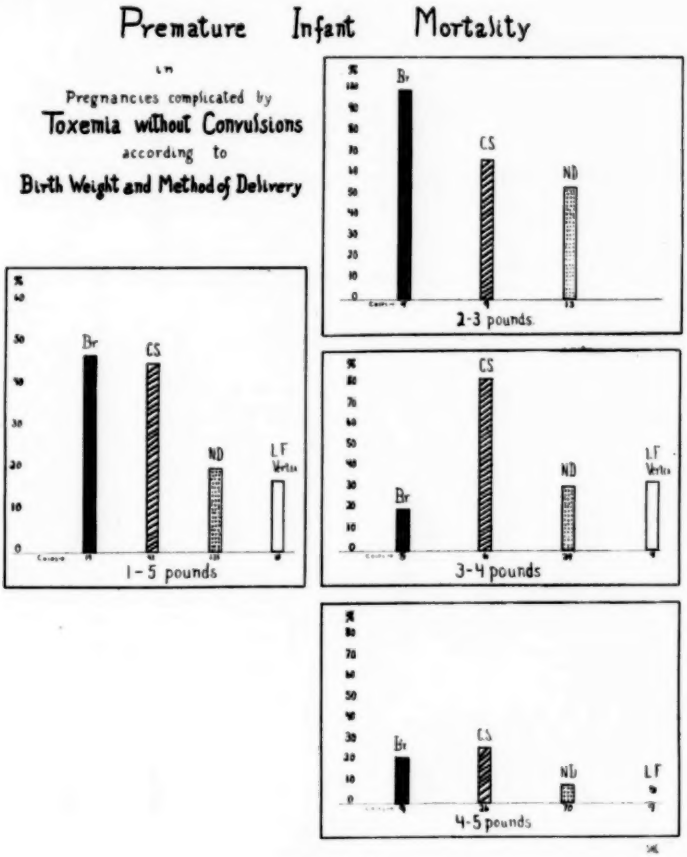

Chart 10.

delivered by beech extraction is understandable. The mortality of 54 per cent for the method that is generally considered to be the "safest" for the delivery of a premature infant, cesarean section, is difficult to explain. The problem has been analyzed in a previous publication[6] and the present more extensive survey of the subject has not altered the earlier conclusions. The preoperative use of morphine was felt to have contributed to the mortality encountered in

delivery by hysterotomy. The influence of anesthesia upon the premature infant was considered as a possible factor. The high rate was not felt to be due to potentially less viable infants being delivered by this method. It was pointed out that while cesarean section eliminated the factor of trauma during delivery it substituted the one of asphyxia in its place. The conclusion drawn was that the

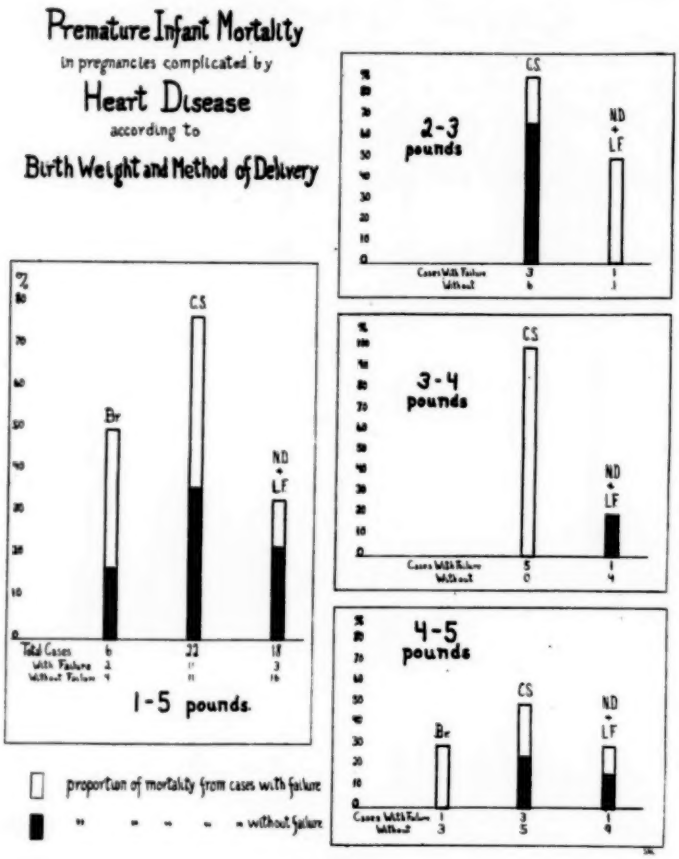

Chart 11.

present technic of cesarean section was distinctly not the method of choice for the successful delivery of a premature infant.

In contrast, vertex delivery assisted by the application of low forceps and episiotomy is associated with a mortality of 15 per cent, which fact makes it by far the safest method for accomplishing the birth of a premature infant. The mortality attending normal vertex

delivery was found to be 33 per cent. The reasons advanced for the favorable showing of low forceps delivery are that the blades tend to protect the head, and that by this method of delivery the head is not left on the perineum for so long a time, thus shortening the period of asphyxia. The episiotomy reduces the resistance of the soft parts.

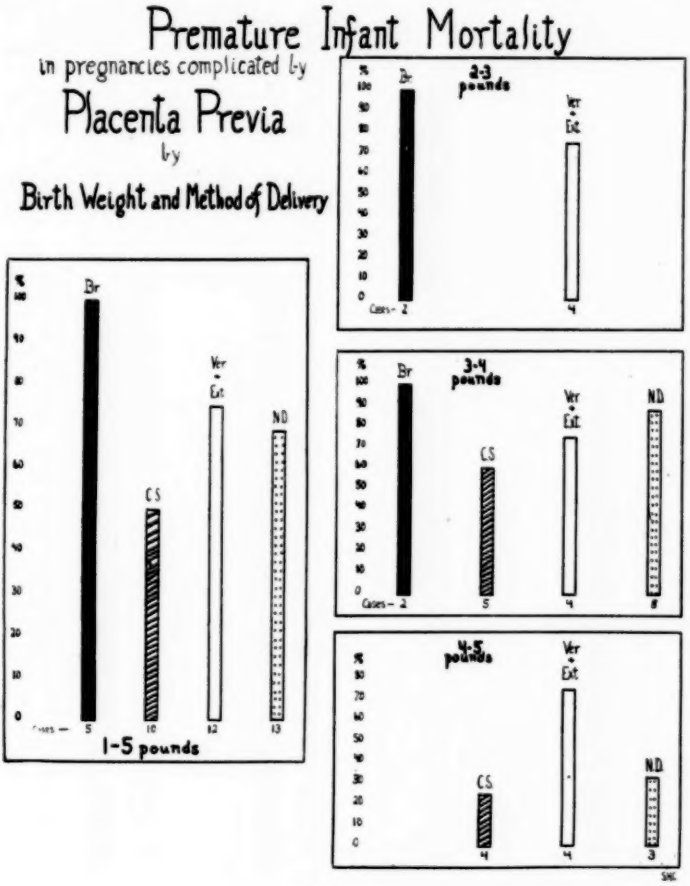

Chart 12.

In order that the influence of the method of delivery upon the viability of the infant might be studied in homologous groups, the cases comprising this series have been subdivided according to the complication of pregnancy present in the mother. When the influence of the method of delivery upon the premature infant mortality is investigated in cases with uncomplicated pregnancy (Chart 9), in those complicated by toxemia without convulsions (Chart 10), and

in cases complicated by heart disease (Chart 11); there is no deviation from the general pattern discovered for the group as a whole. Cesarean section and breech extraction continue to be associated with the greatest mortality, while delivery by low forceps is consistently

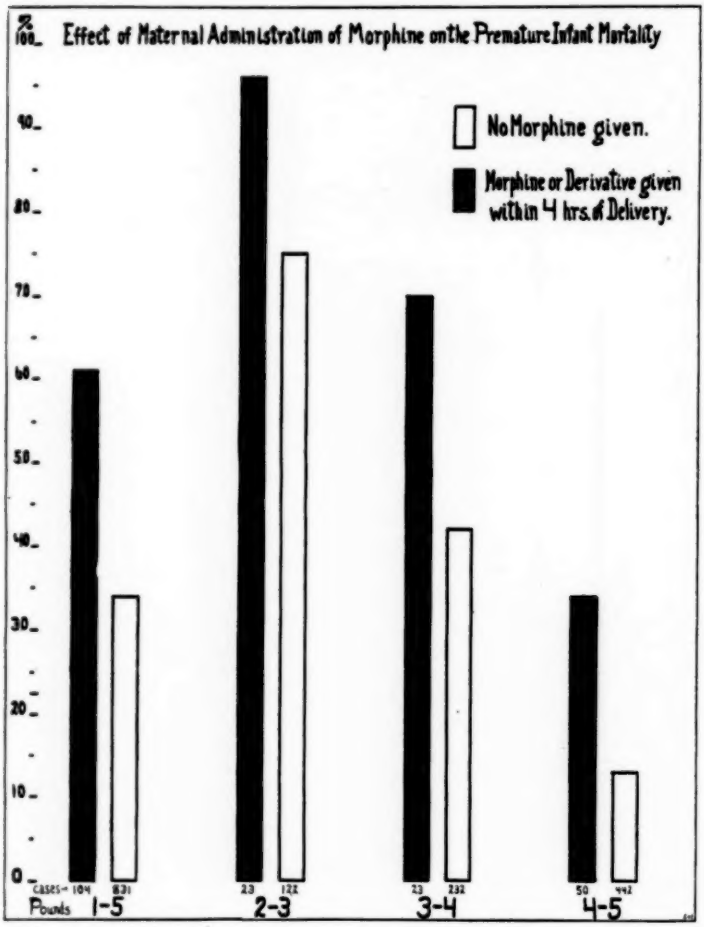

Chart 13.

associated with the lowest mortality. The finding in cases complicated by placenta previa (Chart 12) proves the exception to the rule —while the mortality associated with cesarean section is as high as in other complications of pregnancy, in this particular instance it represents the safest available method for the delivery of a living premature infant.

The future of a premature infant is tremendously affected by the method of its delivery; in general, delivery by cesarean section or breech extraction is more dangerous to the infant than vertex delivery assisted by the application of low forceps.

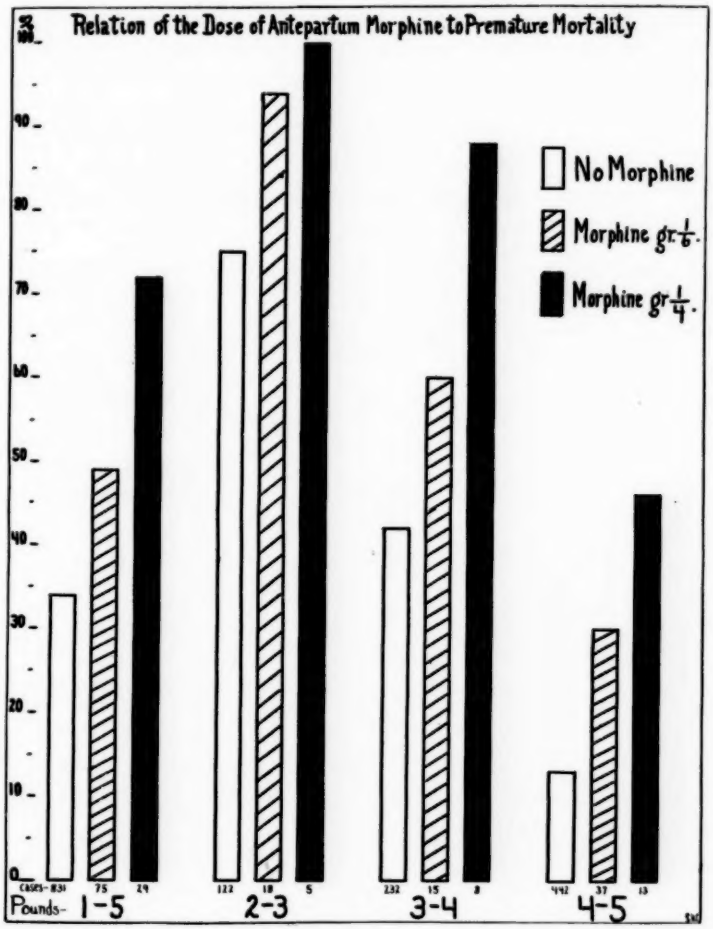

Chart 14.

C. *The influence of the maternal administration of morphine* or its derivative within four hours of delivery upon the premature infant mortality has been considered in Chart 13. The infants of mothers who had received morphine are seen to have encountered twice the death rate of infants whose mothers had not received the drug. The relation of the amount of morphine administered to the premature

infant mortality has been studied in Chart 14—the death rate is seen to increase as the size of the dose increases. The premature infants delivered by cesarean section have been subdivided according to the complication of pregnancy present, and the infant mortality encountered in each of these groups has been considered in relation to percentage of each group in which the mothers had been given morphine prior to delivery (Chart 15). The infant mortality increases as the percentage of each group receiving morphine increases.

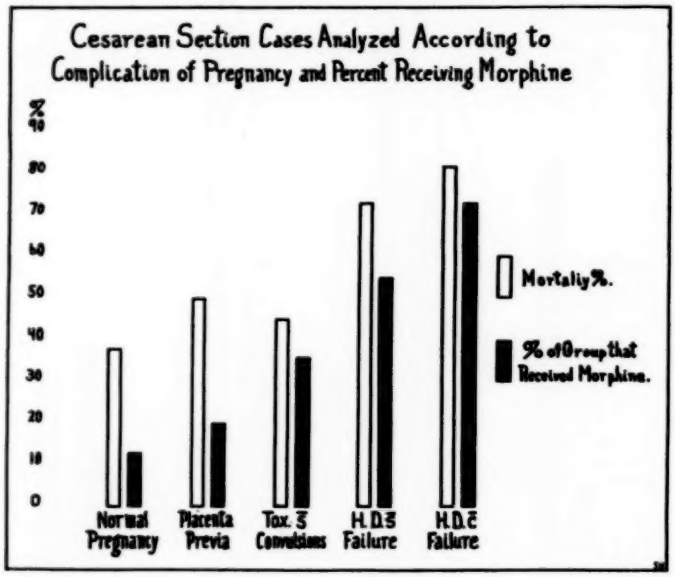

Chart 15.

The maternal administration of morphine within four hours of the delivery of premature infants apparently exerts a direct effect upon the death rate of the infants.

CONCLUSIONS

I. Two plans have been suggested whereby the premature infant mortality may be reduced.

A. Through the possession of knowledge as to the probable weight of the fetus in utero, the time at which pregnancy shall be terminated may be controlled to the best interests of the fetus.

B. As the result of an analysis of the influence of various obstetric factors upon the viability of 958 premature infants the following conclusions have been drawn.

1. The viability of the fetus does not appear to be influenced directly by the complication of pregnancy present in the mother. However, it is affected indirectly by what that complication does to the placental circulation and by the method elected for the treatment of that complication.
2. The future of the premature infant is tremendously affected by the method chosen for its delivery; in general, delivery by *the present technic* of cesarean section or breech extraction is accompanied by a much higher infant mortality than is vertex delivery assisted by the application of low forceps.
3. The premature infant mortality is greatly increased by the maternal administration of morphine within four hours of delivery.

II. The practical application of these findings during the past year is felt to have contributed to the following observed results:

A. The general stillbirth rate was reduced from a ten-year level of 69 per 1,000 deliveries to 47 per 1,000 for 1933.

B. The incidence of premature infants alive at birth increased from an average of 27.6 for the preceding ten years to 34.7 per 1,000 deliveries for 1933.

C. The number of premature infants in the 4- to 5-pound groups increased from an average of 52 per cent for the preceding ten years to 61 per cent for 1933.

D. The premature infant gross mortality dropped for the first time in five years from a level at 35 per cent to 29 per cent. The mortality rate for infants weighing from 3 to 4 pounds was reduced from 40 per cent for the preceding ten years to 24 per cent for 1933.

III. A series of years must pass before definite conclusions can be drawn as to the value of the investigations here presented. The results observed during the past year suggest that the approach to the premature and stillborn infant problem lies in an intensive study of the factors influencing the fetus in utero and during delivery.

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THE OCCURRENCE OF THE *STREPTOCOCCUS HEMOLYTICUS* IN THE THROATS OF CHILDREN ON HOSPITAL WARDS

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THE PROBLEM

THE object of this investigation has been to assemble data pertaining to the incidence of carriers of the *Streptococcus hemolyticus* among the patients and nursing staff of hospital wards for children.

From clinical observations, the following statements regarding streptococci seem to us to be correct and to present a background for evaluating data regarding carriers of this organism.

1. The streptococcus is dangerous in proportion to its virulence.

2. Infection begins when the streptococcus comes in contact with diseased or injured tissue.

3. Carriers of the *Streptococcus hemolyticus* are responsible for many streptococcus infections, including scarlet fever, both in themselves and others.

4. Streptococci are spread from throat carriers by droplet infection especially when the carrier is coughing, sneezing, or crying.

5. In most years 95 per cent of cases of severe sinusitis, including mastoiditis are due to streptococci, and at least 75 per cent to the *Streptococcus hemolyticus*.

Therefore, on a children's ward the streptococcus carrier raises a problem. There are on such wards: (1) children with, or exposed to, or recovering from the prevalent epidemic respiratory infection; (2) children with chronic infections of the nose or ears; and (3) children who have had acute tonsillitis and have cryptic tonsils. Many of these children carry in their throats hemolytic streptococci of greater or less virulence. The nurses taking care of such children may become carriers and in turn aid in the dissemination of hemolytic streptococci. It was to obtain information regarding the actual and varying incidence of carriers that the present study was carried out.

LITERATURE

War Camps and Hospitals.—The first intensive studies on carriers were done in the camps and the hospital wards during the World War.

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At this time it was found that many of the complications arising in the course of pneumonia, influenza, and measles were due to invasion by the hemolytic streptococcus.

Cole and MacCallum[1] found the incidence of hemolytic streptococci in the throats of patients entering a measles ward at an army camp to be 11.4 per cent. Within from three to five days the rate rose to 38.6 per cent. Sixteen days later the rate was 56.8 per cent. A coincident survey in a "tuberculosis suspect" ward showed an average rate of 21.4 per cent. Levy and Alexander[2] found an incidence of 77.1 per cent among 388 patients with measles. Examination of healthy men from a brigade, which had supplied 89 per cent of all measles cases, revealed a carrier rate of 83.2 per cent; of 489 new arrivals into camp, 14.8 per cent were carriers; it was apparent that hemolytic streptococci were readily and easily spread. In another series of measles cases, Cumming, Spruit, and Lynch[3] found 35 per cent carriers.

During the months of March and April, Nichols[4] found the rate ranging from 50 to 90 per cent among the patients and attendants at the Walter Reed Hospital. Blanton and Irons[5] reported 34 per cent carriers in a group of influenza patients.

Walker[6] examined successive groups of recruits entering a training camp. The average incidence was 17 per cent. The personnel of this camp showed a consistent rate of 20 per cent. These men were all presumably well.

Civilian Population.—In 100 normal appearing throats from the population at large, Smillie[7] found a carrier rate of 50 per cent. Ruediger[8] reports 59 per cent in a series of normal individuals, and Otteraaen,[9] 57 per cent. Arnold[10] examined 134 throats and found hemolytic streptococci in 50.7 per cent.

Tonsils and Carriers.—Nichols and Bryan[11] directed their attention toward localizing the focus of infection in carriers. A comparative study was made of cultures from nasal, pharyngeal, salivary, and tonsillar swabbings. Tonsillar swabs were found positive for the hemolytic streptococcus more frequently than any of the others. In a group of fifty cases, 28 per cent were positive by tonsil swab. After tonsillectomy, culture examination of the crypts gave positive results in 50 per cent. In another group of 100 pairs of excised tonsils, 75 per cent were positive when the crypts were cultured. In twenty-five cases of follicular tonsillitis twenty-four were positive for hemolytic streptococci. These authors concluded that the site of infection in carriers was mainly the tonsil and especially the crypts of the tonsils.

A similar study was made by Pilot and Davis.[12] In a group of 100 children, from five to sixteen years of age, about to have their tonsils removed, swab cultures from the pharyngeal wall were positive in

43 per cent. In these cases tonsil-swab cultures were positive in 61 per cent. After excision, cultures of the crypts of these tonsils were positive in 97 per cent. In a control series 58 per cent of all cases with tonsils were positive while 15.8 per cent were positive in those cases without tonsils. Blanton, Burhans, and Hunter[13] reported a carrier rate of 80 per cent in patients with tonsils. Cultures from the crypts after excision were positive in 90 per cent.

Walker[14] made cultures from the throats of 896 healthy recruits. All but twenty-eight still had their tonsils. In the group with tonsils 20 per cent were carriers. In the group without tonsils the incidence of carriers was 7 per cent. One hundred and forty of the men had hypertrophied tonsils; this group showed a rate of 35 per cent. Pilot and Tumpeer[15] determined the rate as 89.3 per cent in a group of children under six with hypertrophied tonsils. A control series of seventy-five children contained 47.7 per cent carriers.

Tongs[16] studied the problem of carriers with special reference to the persistence of that state after tonsillectomy. In 125 cases with tonsils 60 per cent were positive by throat culture; 83 per cent after the crypts were cultured. In a similar group of 342 persons whose tonsils had been removed only seventeen, or 4.9 per cent, were positive. Nichols and Bryan[11] found that in thirty-one positive cases streptococci could not be detected in twenty-seven of the cases eleven days after tonsillectomy.

Meleney[17] in studying a surgical operating room staff over a period of a year found the incidence of carriers greatest in April and May and lowest in the winter.

Helmholz,[18] in 486 cultures of the nasopharynx of children, found an average of 44 per cent positive cultures for hemolytic streptococci. In a group of eighteen patients in private practice, he took cultures at approximately eighteen-day intervals for two years; all the children at one time or another had positive cultures; the percentage of positive cultures for individual children varied from 18 per cent to 65 per cent. There was a variation from month to month, the incidence at times being as low as zero and at others as high as 100 per cent positive. These latter findings were in July and in September.

THE WARDS

The present study was made of patients and nurses on the children's ward of the Massachusetts Eye and Ear Infirmary.

There are three rooms in this ward; the children in one room are not changed to another room, and they do not mingle with the children of the other rooms. The same group of nurses care for the patients in all the rooms. Two of the rooms, of twelve and five beds each, all in glass cubicles, are for ear and throat cases; routine ton-

sillectomy cases are not on this ward. The ear cases are mostly of otitis media and mastoiditis, usually operative and occasionally recurrent; there are occasional cases of secondary lateral sinus thrombosis or brain abscess; there are also a few nonsuppurative cases. The throat cases are of sinusitis, foreign body aspirations, laryngeal stenosis with tracheotomy, esophageal stenosis, dacryocystitis. In these rooms a high percentage of the patients have infections. In the third room, which is for the children with eye troubles, there are thirteen beds, with five cubicles. They do not include the patients with acute purulent conjunctivitis or keratitis. The majority of the cases have had an eye injury, or have strabismus, interstitial or phlyctenular keratitis, cataract, or buphthalmos. Thus the ear-throat rooms are occupied largely by children who have or have had primary streptococcus infections while in the eye room there are almost no such cases. The eye cases may be said to serve as a control group.

PROCEDURE

Throat cultures were taken every Monday morning for twenty-seven consecutive weeks on each patient and nurse then on the ward. In all, 386 cultures were taken on 178 children; on some children, who were on the ward only one Monday, only one culture was taken. Other children had as many as six or seven cultures.

The cultures were taken by passing a swab from one tonsil across the soft palate to the other tonsil. In the absence of tonsils, the fossae were swabbed. The swab immediately was immersed in 1.5 c.c .of low-meat infusion broth to which Na_2CO_3 had been added as recommended by Mueller and Whitman.[19] The cultures were incubated for two hours and then smeared on a blood agar plate as described in detail by Mueller and Klise.[20] In the mastoid cases cultures were obtained at operation of the same patients and examined for the presence of hemolytic streptococci.

OBSERVATIONS MADE

Notes were made on the appearance of the throat at the time each culture was taken. Comparing the culture findings with the appearance of the throat, we were not able to tell if a noninfected throat would give a positive culture. Infected hypertrophic tonsils usually were positive for streptococci.

In Table I are given the results of the cultures for hemolytic streptococci in each of the twenty-seven weeks of the study. The percentage of carriers among the children varied from time to time from as low as 9 per cent to as high as 75 per cent. When the nursing staff was included, similar percentage variations were found.

TABLE I

INCIDENCE OF THROAT CULTURE POSITIVE FOR HEMOLYTIC STREPTOCOCCI ON A CHILDREN'S WARD, 1931-1932

WEEK OF STUDY	MONTH	PATIENTS	POSITIVE CULTURES		PERCENTAGE INCLUDING STAFF
			NUMBER	PERCENTAGE	
1	September	6	1	17	7.7
2		7	2	29	25.0
3		9	1	11	6.3
4	October	7	2	29	13.3
5		12	3	25	21.1
6		18	7	39	34.6
7		24	7	29	21.8
8	November	19	2	11	7.4
9		16	12	75	50.0
10		15	8	53	39.1
11		13	4	31	19.0
12		12	2	17	10.5
13	December	9	2	22	13.3
14		11	4	37	22.2
15		16	7	44	34.8
16		21	6	29	21.4
17	January	19	5	26	23.1
18		11	1	9	12.5
19		9	2	22	14.3
20		12	5	42	33.3
21	February	22	6	27	22.2
22		17	5	29	21.7
23		13	5	38	25.0
24		17	7	41	36.4
25	March	18	7	39	28.0
26		18	13	72	68.0
27		15	6	40	42.9

There seemed to be a high peak in the percentage of positive cultures about once a month; this was independent of the number of patients on the ward.

Chart 1 is a graphic representation of the percentage of positive cultures in the children; also the findings in the cultures of the nursing staff are given. Only one regular nurse and a substitute kindergartner did not become a carrier at some time during the study. Several became carriers near the end of the observations in March,

TABLE II

ANALYSIS OF PATIENTS AS TO CARRIER FREQUENCY AND PREVIOUS TONSILLECTOMY

	BOTH ROOMS	EAR ROOM	EYE ROOM
Total patients	178	103	75
Carriers	78 (43.8%)	46 (44.6%)	32 (42.6%)
Total patients	178	103	75
With tonsils	125 (70.2%)	68 (66.0%)	57 (76.0%)
Total with tonsils	125	68	57
Carriers	65 (52.0%)	37 (54.4%)	28 (49.1%)
Total without tonsils	53	35	18
Carriers	13 (24.5%)	9 (27.1%)	4 (22.2%)
Total carriers	78	46	32
Carriers with tonsils	65 (83.3%)	37 (80.4%)	28 (87.5%)

when the percentage of carriers was high. Eight of the ten nurses had had their tonsils removed. Only Nurse 4 and Nurse 5 retained their tonsils.

Among the children the carrier percentage was practically as high in the eye room as in the ear rooms. A higher percentage of children with tonsils was found in the eye room. This is probably because many mastoiditis cases had had a tonsillectomy performed. Among the children with tonsils a higher percentage of carriers was found than among the children without tonsils. Of the total number of carriers, 83.3 per cent still had their tonsils.

Further data showed that of the 114 children who showed negative cultures at first, fifty had cultures taken again from their throats some subsequent week, and fourteen became positive.

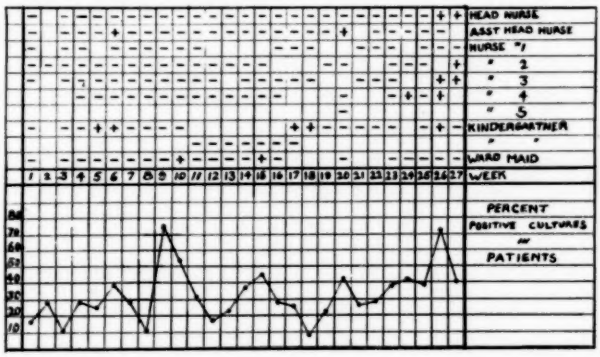

Chart 1.—Throat cultures of nursing staff: "+" indicates that hemolytic streptococci were found, and "–" indicates that no hemolytic streptococci were found.

Eight of the fourteen were in the ear room; three had positive cultures at operation; four changed to positive on the "peak" weeks; three showed signs of a more injected throat with the positive culture, and five showed no change in the throat.

Six of the children were in the eye room; none had infection or increased redness of the throat; three changed on "peak" weeks.

Fourteen children who at first had a positive culture had a negative culture at a later week.

Of the eighteen operative cultures obtained, twelve showed hemolytic streptococci; nine of these patients had positive throat cultures. Of the six with negative operative cultures, four showed positive throat cultures.

In the ear ward there were thirteen cases in which some form of instrumentation was performed, such as the passing of a laryngoscope, a bronchoscope, or an esophagoscope. There were five patients positive

in this group before any instrumentation was done. No others became carriers although many of these patients returned for further treatment throughout the period of the investigation.

SUMMARY

1. There is considerable variation in the incidence of streptococcus hemolyticus carriers on the ward of a hospital from week to week during the fall and winter season.

2. There appears to be a monthly peak in the incidence of carriers. In these observations two peaks of greater magnitude than the others occurred in November and March. This may be an indication of an epidemic respiratory infection in the whole community at that time.

3. Members of the nursing staff tend to become carriers at the "peak" periods.

4. The incidence of carriers among 178 children was 43.8 per cent and was practically as common in a room of noninfectious eye cases as in rooms with many operative mastoiditis cases.

5. The carrier rate among patients with tonsils was higher than among those without tonsils.

6. There is no characteristic appearance of the carrier's throat that makes diagnosis possible without culture.

CONCLUSION

The epidemic respiratory infections in the community seem to play a bigger rôle in the carrier state of a ward than the primary conditions of the patient. Tonsillectomy certainly tends to reduce the number of carriers. Instrumentation did not tend to make a patient a carrier.

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GONAD-STIMULATING HORMONES FROM THE PITUITARY AND FROM HUMAN URINE

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SIX or seven years ago (in 1927 and 1928) the situation as regards the physiology of the anterior pituitary seemed fairly simple. It had been shown (Evans and Long) that a preparation of beef hypophysis injected intraperitoneally would accelerate growth and induce a condition of mild gigantism in normal rodents.

Restoration of growth in animals dwarfed by hypophysectomy was secured thus demonstrating that the growth inhibition secured earlier in pituitary ablations in dogs was actually due to a pituitary deficiency.

The introduction at this time of an operative procedure which made it possible to remove the pituitary in small and commonly used laboratory animals (Smith[1]) proved then and has continually proved since then, of the greatest value in studies on the physiology of the hormones, particularly those stimulating the gonads. Indeed many workers in this field are convinced that all gonadotropic hormones or extracts must finally be tested on hypophysectomized animals, for the added factor of the secretion of the animals' own pituitary in hormone injections makes it difficult to determine the effect of the injected hormone, per se, on the gonads. The use of normal animals, only, may lead to erroneous conclusions.

At this time, also, it was demonstrated that pituitary implants hastened the maturing of the reproductive system in the female, and that implants of the anterior pituitary lobe restored to a normal condition the atrophic reproductive organs of male rats which had been hypophysectomized and effected a partial restoration in females.

The problem of pituitary function at this period thus seemed fairly simple. When growth retardation or sexual hypofunction was of pituitary origin, the indications for treatment seemed clear and not very complicated.

Certain findings made at this time did suggest, however, that the problem might become more complex. It was shown that pituitary abla-

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tion caused, not only, dwarfism and an atrophy of the reproductive organs but other disabilities as well. The adrenal cortex and the thyroid showed a profound atrophy. These could also be restored to a normal condition in rats by anterior pituitary implants. No one could venture to state at that time whether these thyroid and adrenal effects were due to separate anterior pituitary hormones or whether they were due to a deficiency of the growth or of the sex hormone or hormones.

The work since that time from a number of laboratories in this country and abroad has uncovered many new findings, some of which have simplified the problem but in the main have made it more complex. It has increased the number of anterior pituitary hormones from a probable two to a possible six or seven. The growth hormone has remained as an entity, but most all preparations of this principle contain also other active principles. Two anterior pituitary sex hormones and, more recently, still a third have been postulated. Thyrotropic, adrenotropic, and lactogenic hormones have been described and appear to be separate principles. The evidence suggests also a diabetogenic hormone and a fat-metabolizing hormone. That this small gland weighing less than one-half a gram in the human can elaborate all these as distinct hormones is a challenge to the imagination.

The problem has also been further complicated by the discovery of gonad-stimulating or gonadotropic hormones in the urine. These will be discussed more at length later in the paper. It will suffice here to state that these are found only in human urine (and the urine of apes) and that there are two distinct gonad-stimulating urinary principles. One of these is found in pregnancy urine and the other in castrate urine. A principle similar to that present after castration (or ovariectomy) is found also in the urine and blood of women after the menopause. Much work needs yet to be done before the identity or nonidentity of these urinary gonadotropic hormones with those extractable from the anterior pituitary, can be established.

The physiology of the anterior pituitary sex hormones and of the anterior pituitary-like sex hormones in the blood, placenta, and urine is thus complex. It was with some hesitation that the invitation was accepted to present a paper on this problem before a group whose primary interest, it is realized, must lie in the clinical side of this field. The paper is given primarily from the experimental point of view. This must of necessity be the case for we are experimentalists, not clinicians.

Before entering upon a discussion of the gonad-stimulating hormones, it may be justifiable to mention the estrogenic hormones. These substances act directly on the accessory reproductive organs of the female, namely, the uterus, tubes, and vagina. Their secretion is indirectly stimulated by the anterior pituitary which acts on the intermediary reproductive structure which secrete them. The first demonstration of an

estrogenic substance, secured by aspirating and injecting the fluid from the follicles of sow's ovaries into spayed rats and mice, did not suggest the many sources of the estrogenic principles or that a difference in their chemical formulas would be found.

The estrogenic hormones are prepared from three main sources, human pregnancy urine, mare pregnancy urine, and the amniotic fluid of cows.* A recent note by Zondek[2] states, however, that the urine of stallions is the richest known source of this material. Its occurrence also in urine of men has been known for some time.

Commercial preparations are made from the three main sources of estrogenic substances named above. The large number of trade names used for the commercial products does not simplify the problem.

Also before entering upon a discussion of the action of the pituitary sex hormones, it seems wise to discuss briefly the rôle of the receptor tissues, i.e., the capacity of the tissues to respond to hormones. The effect produced by hormone administration necessarily depends not only on the stimulating capacity of the hormones but also on the reactiveness of the tissues of the organism. The sum of the two determines the ultimate effect. Data upon the responsiveness of the tissues are scattered and scanty but are sufficient to suggest that this phase of the problem is important. A few examples will be given.

In experimental studies on morphogenesis, which have been carried on extensively in amphibia, it has long been the practice to transplant organs or appendages from species of one size to closely related species of a different size. In such transplants it has been uniformly found that the size of the transplanted organ is dependent on the size of the donor, not of the host or recipient. A limb, for instance, which comes from a large species will become much larger than the limb of a small species though the two are in the same endocrine environment. The inherent capacity for growth as has been discussed, especially by Harrison (Harvey Lectures 1933 and earlier), is different in the two and when subjected to the same amount of circulating hormone their differential growth rate is still maintained. The rate of growth is thus not entirely controlled by the endocrine milieu but is a function also of the growth capacity of the organ.

This fact has also been brought out in a striking way by Stockard in the interbreeding of different strains of dogs. Thus, if a dog of one strain which has short jaws is bred with a dog of another strain which has long jaws, an offspring may be produced which has one short and one long jaw. The size of the jaw is thus not determined primarily

*The chemical formula of the estrogenic substance in the amniotic fluid of cows has not been published. From human pregnancy urine (and from the placenta), however, two estrogenic substances have been secured, theelin and theelol. The latter is more effective by mouth than by injection. Three principles (equilnine, equilenine and hippuline) all of which differ in their chemical formulas from theelin and theelol have been secured from mare pregnancy urine.

by the endocrine environment, but by the rate of growth inherent in the jaw itself. It must be recognized of course that for the maintenance of this inherent rate of growth an exposure to a certain amount of the growth hormone is necessary except, probably in the earlier stages of life. Racial size, however, from these experiments cannot be referred solely to the activity of the endocrine glands but is also dependent on the hereditary responsiveness of the tissues to the endocrines and to the hereditary growth rate of the species. Other examples could be given which also show this.

In the early stages, development appears to be quite independent of the stimulus from growth hormone. A number of investigators have removed the pituitary in amphibia before this gland has shown any structural differentiation. The growth rate of these operated larvae is but slightly retarded, and they may ultimately reach the size of the intact tadpole. If the pituitary of a rat is removed at the weaning date, considerable skeletal growth will subsequently take place. If it is removed later in life, however, no growth whatsoever takes place subsequent to the operation though it was operated upon during the period of growth. It is unfortunate that the operative procedures in mammals make it difficult or perhaps impossible to determine whether ablation of the pituitary at birth would interfere in any way with growth in the early part of the life span. It seems fairly safe to predict, however, that no pronounced growth inhibition would early take place. Though few in number, the demonstrations which have been made of the decreased importance of the hormones in the earlier stages of development should make us hesitate to refer early disturbances in growth, for example achondroplasia, to a hormonal deficiency or unbalance.

It is known, however, that the structure and functioning of the endocrine organs themselves may be genetically influenced so that, with a normal tissue responsivity to endocrine stimuli, disabilities may arise. The best example of this is afforded by a strain of mice in which dwarfism is hereditary and occurs in a Mendelian ratio. The strain has to be propagated by the breeding of heterozygous, apparently normal animals, of this strain. In these dwarf offspring, growth is normal for the first fifteen days of life. It then abruptly slows and subsequently takes place but slightly, if at all, for the remainder of the life span. The anterior pituitary is undersized and contains no acidophilic cells. Assay of these pituitaries reveals the presence of no growth hormone in them, though the sex hormone is normal in amount. This example shows that not only is the pituitary dependent for its normal functioning and structure on the genes but that particular cells secreting specific hormones are influenced by heredity.

The final point in regard to tissue reactivity which we wish to mention is the varying responsivity of organs with aging. The data so far

available on this point apply particularly to the reproductive organs. Ovaries of very young animals fail to respond to the follicle-stimulating gonadotropic extracts though small follicles are present in abundance, which, it seems, should be able to be stimulated to growth. Below the age of about fifteen or sixteen days (in rats) some aging factor has not operated which is necessary in order for them to be responsive to the follicle-stimulating hormone. In the male the administration of gonadotropic products has not unquestionably hastened sexual maturity. It appears that the aging factor must operate longer in that sex than in the female before sexual maturity can be induced.

We will now return more directly to the action of the gonadotropic hormones and will at the end attempt to indicate or predict, whether wisely or unwisely, what beneficial effects may be hoped for by their administration. Experimentalists fully appreciate that widely different responses may occur between laboratory animals and the human being. In spite of this the best procedure usually appears to be to test these products on animals first, realizing at the same time that the final test must be made in the clinic.

We will discuss first the urinary gonadotropic hormones. Shortly after the time that the sex-maturing effects of anterior pituitary implants were discovered in this country and abroad (Smith and Engle,[3] Zondek and Aschheim[4]) Aschheim and Zondek reported the presence of a large amount of gonadotropic hormone in human pregnancy urine. This substance begins to be secreted very early in pregnancy, even before the next expected menstruation, and gradually decreases in amount near the termination of pregnancy. It is found in the maternal blood, in the fetus and in the placenta in large amounts. Extensive studies have been made on the action of this substance in normal animals and, more recently, in hypophysectomized animals. It is being widely used clinically and unfortunately comprises the only gonadotropic hormone preparation commercially available.* Zondek long maintained that it was of pituitary origin but the difference between it and true pituitary products has gradually led to the belief that it is not elaborated by the pituitary and, consequently, that its use does not constitute a true pituitary therapy.

A year after the announcement of this substance in pregnancy urine, called prolan by Zondek, Fluhmann[5] reported in the blood of ovariectomized women, a substance which gave different effects from pregnancy urine extracts when injected in normal immature rodents, and a year later (1930) Zondek reported the presence of this other substance in the urine of ovariectomized women. It is found also in quite large amounts

*Since this was written, a gonadotropic preparation made from the anterior pituitary has been placed on the market by an American firm.

in the urine of women after the menopause. Hamburger[6] has estimated that some 3,000,000 units is excreted in the postmenopausal part of an average life span. Only within the last year, however, have any comprehensive studies on this principle in castrate urine been reported (Hamburger), and the brief papers published by our group at Columbia are the only ones which have thus far appeared on the response evoked by this substance in the absence of the pituitary, that is in hypophysectomized animals.

Differences in the responses which are induced by injections of pregnancy urine extracts and of castrate (or menopause) urine extracts are

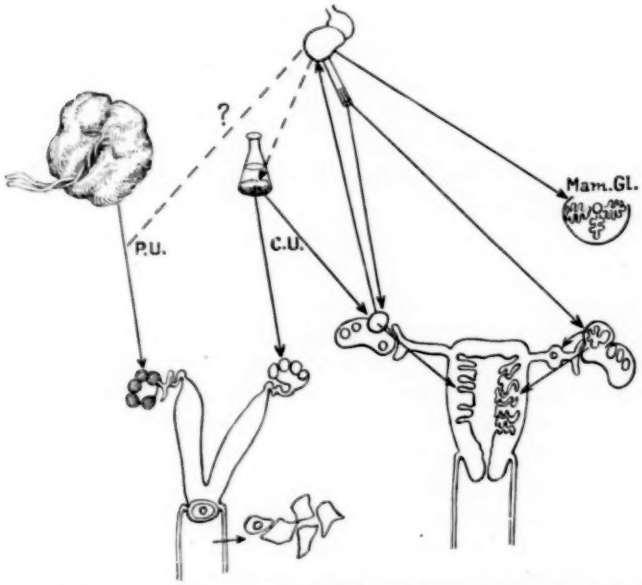

Fig. 1.—Diagram of certain hormonal relations of the female genital system.

The abbreviations P.U. and C.U. refer respectively to extracts made from human urine of pregnancy and of postmenopausal patients or from female castrates. The assumption is made that P.U. originates in the human placenta although it may contain some factors from the anterior pituitary. In the diagram it is indicated that P.U. causes luteinization in the rat ovary while C.U. causes follicular growth. The extract C.U., symbolized by the flask, is so similar to anterior pituitary extract that it may be provisionally considered to be of anterior pituitary origin. Since the question of two substances in the anterior pituitary, a follicle-stimulator and a luteinizer, is still a moot point, the diagram is devised so that the reader may interpret it either way. The action of estrin from the ovarian follicle on the anterior pituitary is accepted for experimental animals. Similar action is not known to be true for the human.

very evident in normal animals. They are even more striking in the pituitaryless rat of both sexes.

The response of normal immature female rats or mice to pregnancy urine extracts is well known. The ovaries are stimulated but instead of maturing many follicles such as is the case when anterior pituitary

implants are given, but few follicles are developed and these usually to not ovulate but become hemorrhagic or form corpora lutea with imprisoned ova. Castrate urine extract on the other hand induces the growth of many apparently normal follicles which do not become hemorrhagic. With treatments lasting only through the usual four-day period corpora may form, however, in normal animals.

Although the difference in the effects produced by these two urine extracts are pronounced in the normal young rodent, even more striking differences are shown in normal female monkeys. Pregnancy urine extract injections in them as has been especially emphasized by Engle[7]

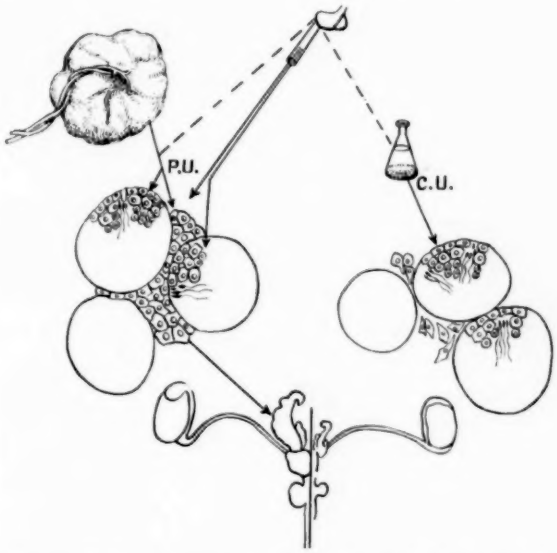

Fig. 2.—Diagram of certain hormonal relations of the male genital system.

Symbols are the same as in Fig. 1. It is accepted that the anterior pituitary in the normal animal maintains both the interstitial cells and the tubules. The extracts of P.U. act primarily on the interstitial cells with, thereby, a maintenance of sperm function, and the accessory organs. C.U. on the other hand, appears to act mainly on the tubules in the immature hypophysectomized rat, permitting the accessories to atrophy.

cause no follicular growth but "dry up" or hyalinize the follicle. Secretion by them of estrogenic hormone is not stimulated. Evidence on the effects of injecting this substance in women is not extensive, but work which has been reported (Geist) indicates that the response of the human may be similar to that of monkeys. If this effect in women is confirmed, therapy directed toward a restoration of ovarian function or the stimulation of ovarian function in delayed development by injections of pregnancy urine will be not beneficial but harmful.

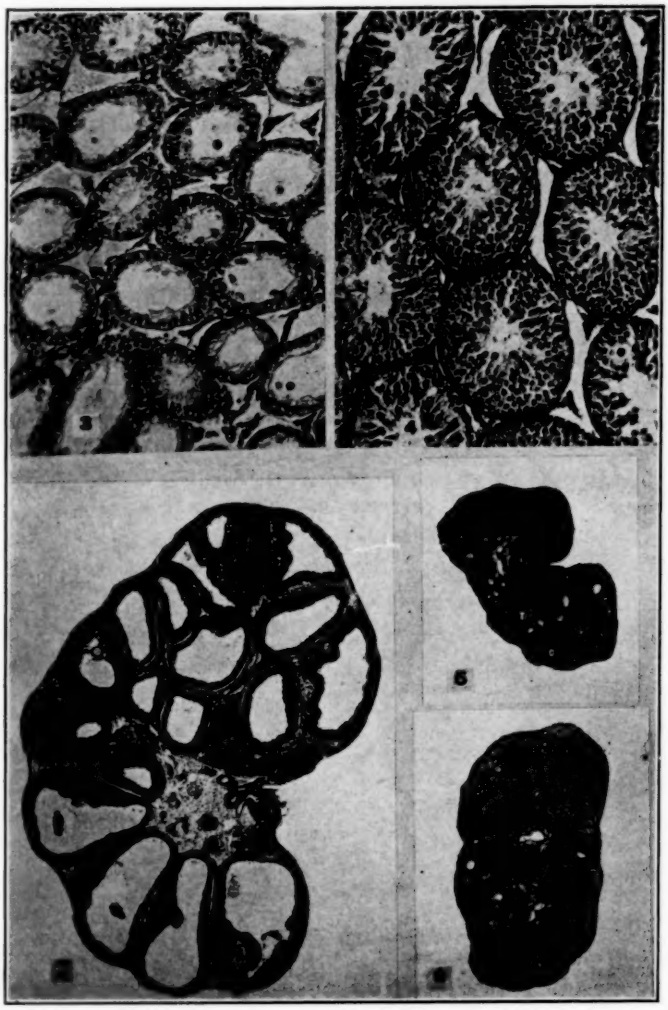

Fig. 3.—Left testis of an immature rat forty days after hypophysectomy. After the ablation of this testis, the animal was injected with an extract castrate human urine (20 c.c. urine-equivalent daily) for twenty days and then autopsied.

Fig. 4.—Right testis of above animal at the termination of the treatment. Although sperm were not present at the time of hypophysectomy (as shown by littermate controls) and the testes had in addition undergone a profound postoperative atrophy, nevertheless, the treatment had caused a marked enlargement (three and one-half times) and tubule activity with the production of motile sperm. Figs. 4 and 5 have the same magnification, ×144.

Fig. 5.—Ovary of an untreated immature rat twenty days after hypophysectomy.

Fig. 6.—Ovary of an immature rat twenty-five days after hypophysectomy. Following a postoperative nontreatment period of fifteen days, an extract of P.U. (25 R.U. daily) was injected for ten days. Note formation of lutein-like cells and absence of follicular growth.

Fig. 7.—Ovary of an immature rat twenty days after hypophysectomy. Following a postoperative nontreatment period of fifteen days, an extract of castrate urine (20 c.c. urine-equivalent daily) was injected for five days. Note formation of many normal follicles and but slight indication of luteinization. Figs. 5, 6, and 7 have the same magnification, ×27.

Castrate urine extracts in monkeys, on the other hand, induce marked follicular growth and stimulate the secretion of the female sex hormone. In the monkey and in the rat, this treatment has not been observed to cause the cystic degeneration of the follicle so often seen with anterior pituitary extracts. Treatments of humans with this substance have not been reported so far as we are aware.

The effects produced by injection of these two urinary gonadotropic substances, in hypophysectomized females show very striking differences. Both cause an enlargement of the ovaries. In the case of pregnancy urine injections, however, the enlargement is due not to follicular growth but to a general hypertrophy of the interstitial tissue and of the theca cells. Typical though small, apparently normal corpora may be found in this "luteinized" ovary. Castrate urine on the other hand causes a marked follicular growth in which luteinization is rare or occurs only after long treatment (Figs. 5, 6, and 7). These injections do not induce ovulation in the hypophysectomized rat, however, so far as we have determined, but this may be stimulated by the subsequent injection of other extracts (pregnancy urine extract).

All experimental and clinical work with which we are familiar indicates that the prospect of stimulating ovarian function in higher forms including the human is not going to be as easily accomplished in the female as in the male. Fortunately, experimental work suggests that success may be fairly easy to attain in the male. Experimentally, however, as in the female there are marked differences in the reaction of the male reproductive tract to the two urinary products under discussion. Pregnancy urine extracts cause a marked hypertrophy of the interstitial tissue of the testes and presumably through the stimulation of this tissue cause the secretion of male sex hormone which induces an enlargement of the accessory genital organs. As shown by Engle[8] in immature monkeys, injection of this extract causes a precocious descent of the testes. Clinical work indicates its value in boys in whom testicular descent is delayed. Although earlier work indicated that this substance might injure the seminiferous tubules, injections of more purified extracts show not only no destructive effects in moderate dosages, but appear to stimulate activity of the seminiferous tubules.

Treatment of hypophysectomized male rats with pregnancy urine, in the experience of Smith and Leonard,[9] also indicated that it has a beneficial effect on seminiferous tubules although others (Collip, et al.[10]) maintain that no effect on the tubules is observable. We are willing to grant that the predominant testicular effect is on the connective tissue derivatives, the interstitial tissue. Hypertrophy of the accessories invariably takes place with pregnancy urine injections whether normal immature or hypophysectomized animals are used.

In injections of castrate urine extracts into hypophysectomized male rats, the beneficial effects on tubule function are much greater than in the pregnancy urine injections (Figs. 3 and 4). Division of the germ cells is strongly stimulated. Multiplication rather than maturation of these cells, however, appears to dominate the picture, so that in a majority of the tubules in the testes of rats, which were immature at the time that the pituitary was removed and treatment begun, or whose testes were allowed to atrophy before treatment was instituted after hypophysectomy, show in some of the tubules many layers of germ cells whose nuclei appear to be abnormal. They have a signet ring type of nucleus. Other tubules, however, are normal and are filled with normal appearing sperm and the epididymis contains motile sperm.

In contrast with pregnancy urine treatments, the interstitial tissue of the testes of these immature hypophysectomized rats treated with castrate urine extracts is not hypertrophied, and the accessory organs show but a slight response, being profoundly atrophied. The latter approach a castrate condition. Thus the response elicited in the testis from the castrate urine injections is predominantly in the germ cells, not in the connective tissue derivative, the interstitial tissue. It is the opposite of that elicited by pregnancy urine treatment.

Since the predominant effect of pregnancy urine preparations is on the interstitial tissue of the testes and that of castrate urine is on the germ-cell line, it seemed probable that combined injections of extracts of both of these types of urine would give more beneficial effects than would the injection of either of them alone. Our results in cases of testicular underdevelopment or atrophy due to an anterior pituitary deficiency have shown that such is indeed the case. The seminiferous tubules appear more normal than in the cases in which one substance only was injected, and the sperm were more numerous both in the tubules of the testes and of the epididymis. Obviously, the accessories would be more normal than when only castrate urine was injected.

From the results obtained in normal and in hypophysectomized animals of both sexes, it is quite evident that the gonadotropic hormone in pregnancy urine and in castrate urine are physiologically quite different, and the one which should be used in each case will depend upon the disability which is to be corrected. The source of the material is thus of great importance. Several pregnancy urine extracts of high potency are available, for clinical use, but so far as we know none from castrate urine is procurable from commercial houses, even for experimental work. In our work, we make our own extracts.

Investigations on methods of preparation of gonadotropic extracts from the anterior pituitary itself have been vigorously pursued for several

years. There is a great species variation in the pituitary content of sex-stimulating hormone, the reason for which is unknown. It does not appear to be correlated with the sexual activity of the species. For instance, the pituitary of the beef is low in potency. That of sheep is high but appears to be surpassed by that of the human and perhaps also by that of the horse. Early in the work on the pituitary sex hormones carried on in the female, the concept was formed that the pituitary secretes two gonadotropic hormones, one of which induces follicular growth and the secretion of the female sex hormone, and the other luteinization and the secretion of progestin, the hormone of the corpus luteum. The female sex hormone and progestin, in turn, have their specific effects on the uterus. Such a concept of the pituitary-gonad mechanism, a I-II reaction, is adequate and is harmonious with certain of the phenomena of the reproductive system. In rabbits, for instance, during their long periods of heat, follicles are continually growing to a nearly mature size but instead of spontaneously ovulating, they regress and are replaced by other follicles. Coitus stimulates the pituitary to release a new or an additional amount of hormone, which causes ovulation and the development of corpora lutea. Also extracts of pituitaries of certain animals more readily produce follicular growth (guinea pig, Lipschutz) whereas those from other animals (beef) give notably not follicular growth but luteinization. The gonadotropic hormone in castrate urine is presumably secreted by the pituitary. As has been pointed out, it predominantly stimulates follicular growth, not luteinization, so that it seems that in the human the pituitary, under certain conditions, can secrete an almost pure follicle-stimulating hormone in large amounts.

Both the Wisconsin and Chicago laboratories, especially the former, have attempted to separate by chemical fractionation the two hypothetical sex hormones in the pituitary. Their physiologic tests have been made largely, however, on normal animals where, as has been pointed out, the animal's own pituitary may confuse the findings. Some of the later evidence from the Wisconsin laboratories is especially impressive, but further work on the problem is necessary.

Our evidence secured largely by the injection of extracts of castrate urine indicates that two gonadotropic hormones may operate in the development and maintenance of the male reproductive system, as has been postulated by others in the female. From the evidence which we have presented, it is clear that the principle in castrate urine fails to stimulate one of the essential functions of the testes, namely the production of the male sex hormone, since the accessories of the treated animals were atrophic. Some other substance is essential for this and also to aid in the maturation of the sperm. The action of sex fractions

of the anterior pituitary itself have so far as we know not been investigated in pituitaryless males.

It may not be wise for a group, from their work in the experimental field, to attempt to predict or suggest as to the prospect for successful therapy in the human from the use of anterior pituitary sex or other hormones. Since our work, however, whether we will admit it or not, is ultimately directed toward the restoration of those who are abnormal, we may be justified in attempting to evaluate the outlook provided that in doing so we keep in mind that it is a long step from the lowly rodent or even from the monkey and ape to man. We have to keep in mind that different species do not always respond in a similar fashion. This appears to be true especially as regards the gonadotropic hormones. An illustration of the great difference in the response of the immature rodent and the monkey to pregnancy urine extracts has already been given.

As regards underdevelopment or underfunction of the ovaries, it would seem that little aid can be expected from the injections of pregnancy urine extracts. Involution, not restoration of the ovaries, would be anticipated. Since this is the gonadotropic preparation now widely marketed under different trade names it should be realized that its administration does not, in all probability, constitute a true anterior pituitary therapy, for the evidence indicates that it is of placental, not of pituitary, origin. In ovarian underdevelopment and underfunction, castrate urine extract seems more promising. It at least induces follicular growth and estrin production without apparently having as great a tendency to produce cysts as do implants of the anterior pituitary itself. In the use of this material it appears that difficulty may be met in attempting to secure ovulation from the developing follicles and also in securing their subsequent transformation into corpora lutea. The problem of securing a restoration of ovarian function will surely be attended with many difficulties.

In the male the prospect of remedying underdevelopment and underfunction of the gonads is better. That this would be the case was early indicated in treatment of hypophysectomized rats with pituitary implants, in which it was found that the male reproductive organs could be restored completely, whereas, in the female this treatment resulted in the production of cysts as well as some normal follicles. Recent work, both experimental (Smith and Leonard) and clinical (Brosius and Schaffer[11]) indicates that in moderate doses purified pregnancy urine extracts will not only not injure the testes but also will augment tubule function. It appears, however, that castrate urine extract will be more effective than pregnancy urine extracts in stimulating tubule activity and

sperm production. Even more effective is the combined injection of both of these extracts. It is quite possible that extracts made directly from the anterior pituitary gland itself will be developed which will be more effective than the urinary preparations.

The value of pregnancy urine extracts in cases of undescended testes appears to be established. Engle suggested from his experimental findings in the monkey that this treatment might be effective in boys, and the reports confirming his prediction have been gratifying. It is hardly necessary to remark that this treatment cannot be effective in cases in which purely mechanical causes are responsible for the retention of the testes.

It was pointed out in the preceding discussion that hormones did not operate in a uniform manner in every segment of the life span. We desire to emphasize again that hormone action depends not only on the nature and potency of the hormone but also on the reactivity of the receptor organ.

This is especially true of suspected hormonal deficiencies in the prepubertal years. An example might be cited of boys with cryptorchid testes. It is possible that an infant of three years might respond if the treatment were prolonged. It is strongly suspected, however, that if the treatment were delayed until the boy was twelve or fourteen years of age, the response would be more rapid and more generally effective, because the normal growth processes of the child would enhance the receptivity of the treated testis.

Conservative and, as far as possible, controlled clinical observation has been and will continue to be of the greatest value in this work. The experimentalist can secure leads and perhaps warn of dangers, but the clinician must make the final tests. In these tests it is of the greatest importance that the variability in the rate of development be kept in mind. Endocrine clinical literature is filled with case reports in which remarkable stimulation, for instance, of growth, is reported in individuals treated within the puberal time range with products which could not possibly stimulate growth. Nature by delaying the puberal growth spurt surely contributes to many of these cures. Happily for the reputation of the pediatrician, these reported cures are usually made after the patient has entered the precinct of the internist.

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OSTEOMYELITIS AMONG CHILDREN

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IT IS agreed that osteomyelitis is essentially a disease of childhood and so commands the interest of the pediatrician in conjunction with that of the surgeon. By the term "osteomyelitis" we mean usually those infections of bone due to the pyogenic organisms, staphylococci and streptococci. Often in discussions, as well as in publications on this subject, it is to be noted that relatively few illustrative cases are cited, and recommendations for treatment do not seem to be based on a sufficiently broad foundation, and not always on cases observed for a sufficiently long time. The necessity for further work seems obvious.

The report we are submitting is based on a total of 394 patients, who were less than fifteen years of age. In thirty-four cases, the lesions were confined to the head, but mastoiditis and its sequelae were excluded. The head presents rather special problems; therefore, some parts of our report are limited to the 360 remaining cases. The patients came under observation during the period from 1921 to 1933. In many cases the time of observation was very limited. Some patients returned several times. We were able to keep in touch with the condition of others by correspondence with the family or the attending physician; concerning still others we were unable to obtain follow-up information. In a number of cases the disease had lasted months or years before the patients came to our attention, and at times it was impossible to get either detailed or reliable histories. Concerning an illness which can extend over many years, with long periods of quiescence, exact statistical data are not easily obtained. Realizing the difficulties of gathering exact data on the subject, as well as those due to our particular situation, we can offer only rather tentative figures.

The distribution according to age of onset has been given somewhat differently by various authors. For instance, Schuchardt[11] placed the onset in the majority of cases in the period from eight to seventeen years of age. Starr[12] placed it at from two to ten years, and Phemister[6] stated that in more than half of the cases the onset occurred between the ages of ten and sixteen years. Trendel[13] assigned

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the onset to the first decade of life in 28.6 per cent, to the second decade in 60.8 per cent, and to the third decade in 7 per cent of 1,051 cases (from none to five years in 8.6 per cent; from six to ten years in 20 per cent; from eleven to fifteen years in 33.9 per cent; from sixteen to twenty years in 26.9 per cent, and from thirteen to seventeen years in 38.7 per cent of all). The distribution by age in our cases is given in Table I, but it is to be noted that we are considering only patients less than fifteen years of age.

It is remarkable that the onset in only thirteen of Trendel's 1,051 cases occurred in the first year of life, whereas the corresponding number in our smaller series was sixteen. Osteomyelitis can occur very early in life; indeed it has been reported as of congenital occurrence.[10] The earliest onset in our series of cases was at three weeks

TABLE I

DISTRIBUTION BY AGE IN 394 CASES OF OSTEOMYELITIS OF CHILDREN

AGE, YEARS	CASES	PER CENT	
0 to 1	16	4.1	
1 to 2	8	2.3	
2 to 3	16	4.1	78 cases = 22.3 per cent
3 to 4	15	3.8	
4 to 5	23	5.8	
5 to 6	16	4.1	
6 to 7	23	5.8	
7 to 8	43	10.9	155 cases = 39.3 per cent
8 to 9	30	7.6	
9 to 10	43	10.9	
10 to 11	42	10.7	
11 to 12	35	8.9	
12 to 13	37	9.4	160 cases = 40.6 per cent
13 to 14	28	7.1	
14 to 15	18	4.6	

of age. The infant had boils on the head and neck, swelling of the right thigh, and osteomyelitis of the upper part of the femur. In four cases, in which the disease started in the first year of life, the osteomyelitis involved bones of the head. In only one case was separation of an epiphysis noted, and in that case the femur was the bone involved.

The distribution by sex is given differently by different investigators, although more of the patients are said to be males than females in such proportions as 4:1 or 3:1, or perhaps males are stated to be only slightly preponderant. In our series, males made up about two-thirds of the total.

All authors agree that peculiarities of growing bone enter into consideration, and this view is supported by experiments on animals; in such experiments it was found necessary to use young animals in

order to obtain results. In experiments in which microorganisms were injected, an injury to the bone determined the localization of the osteomyelitis. An infection following an injury such as a compound fracture is readily understood; this happened in six of our cases. In one case the disease followed a gunshot wound. Several times blisters on the foot, caused by wearing new shoes, started the infection. Falls, accidents incident to play and participation in sport, such as twisting, wrenching, and so forth, can give rise to the infection. At times such injuries seem to be insignificant; at times there is delay of a week or more before the outbreak of the disease, and in one, at least, of our cases the injury happened to one leg whereas the disease appeared in the other.

A rather definite history of injury was obtained in 109 of our 360 cases. Sometimes an injury is combined with an infection; for instance, a blister on the heel becomes infected, or an infection of the skin may precede the injury. In one of our cases, the condition started with a boil on the knee, which was hit twice with a baseball. In thirty-four cases, boils were present at the time of onset of the osteomyelitis, or shortly before.

It has been stated that osteomyelitis can follow exposure, sore throat, or infectious diseases, and among our cases are some examples of this. Exposure alone, or exposure with tonsillitis, was especially mentioned as preceding the illness in five instances; influenza, in four; measles, in three; scarlet fever, German measles, pneumonia, chicken-pox, and whooping cough each in one, and in one, special significance was attached to bilateral conjunctivitis. In one case measles, and in another case exposure, preceded an exacerbation. These are not all the cases in which infectious diseases preceded, or occurred in the course of the illness, but in these cases the onset of the osteomyelitis fell within, at the most, two weeks of the occurrence of the infectious disease. In these cases the lesions were often limited to one bone. Judging from the experiments of Lexer,[3] one might have expected that preceding infections might favor more extensive osteomyelitis. His important experiments well deserve to be recalled here although they were published thirty-eight years ago. He was able to reproduce osteomyelitis in young rabbits by intravenous injection of attenuated *Staphylococcus aureus* and attenuated *Staphylococcus albus,* without first injuring the bone. The lesions remained limited to one bone. Infection by bacillus of Schimmelbusch, followed by the staphylococcus, produced much more extensive lesions than those produced by the staphylococcus alone. The bacillus alone produced only hyperemia of the bone marrow. The mixed infection, furthermore, resulted also in periosteal and parosteal suppuration. With streptococci it was

much more difficult to produce a suppurative disease of bone. When such disease occurred, it was similar to the disease caused by staphylococci.

As in the cases of others, so in the great majority of our cases in which cultures were made, staphylococci were grown, very rarely with staphylococci and streptococci, but sometimes streptococci alone, either hemolytic or green-producing, and in one case, both.

The partition of the disease among various bones is given in Table II. It is compared with the distribution given by Schuchardt and also with that given by Trendel. Both Schuchardt's and Trendel's tabulations come from the surgical clinic of Tübingen, and the latter includes the former.

As generally accepted, numerically, involvement of femur and tibia together are preponderant. But the distribution of involvement of femur and of tibia taken separately does not seem to be settled. In the first 440 cases, the distribution of involvement of femur and of tibia was equal, but to reach a percentage of 45 for the femur, and of 34 for the tibia, in the total of 1,110 cases, means that of the remaining 670 cases, in 50 per cent the femur must have been involved.

TABLE II

BONES AFFECTED IN CASES OF OSTEOMYELITIS OF CHILDREN

CASES	AMBERG AND GHORMLEY 360	SCHUCHARDT 440	TRENDEL 1110
	PER CENT	PER CENT	PER CENT
Femur	38.9	38.5	45.8
Tibia	39.4	38.5	34.8
Humerus	13.6	11.1	9.2
Radius	7.5	5.1	3.9
Fibula	6.4	3.4	3.2
Ulna	3.0	3.4	3.2

The participation of other bones in our cases was as follows: pelvic bones, 8.3 per cent; small bones of hands and feet (with the exception of the calcaneus and talus), 7.3 per cent; calcaneus, 5.8 per cent; clavicle, 4.4 per cent; scapula, 3.3 per cent, and talus, 2.5 per cent. The ribs were involved in four cases, the spinal column also in four cases, and the patella in two cases. Not included in this list are six cases in which osteomyelitis of the ribs, after resection of ribs for postpneumonic empyema, kept the empyema active. The empyema was cured after removal of the osteomyelitic tissue. Bones of the head were involved in 9 per cent of the total of 394 cases. It is of interest to note that of the larger series of cases reported by Trendel, in 2.8 per cent the bones of the head were involved.

A rather distinct difference is seen in the number of cases in which the disease is limited to one bone and that in which more than one

bone is attacked. With this in mind, Trendel reported that of the series of 1,058 cases, in 84.3 per cent the disease was limited to one bone, whereas in 15.7 per cent more than one bone was involved. In our series of 360 cases, in 68 per cent one bone was involved, and in 32 per cent involvement was multiple.

The frequency of involvement of various parts of the long bones is given differently by different investigators. The distinction is not always easy, so we refrained from tabulating our cases. Trendel, utilizing 1,299 cases for this purpose, gave the figures shown in Table III.

TABLE III

INVOLVEMENT OF VARIOUS PARTS OF LONG BONES IN OSTEOMYELITIS OF CHILDREN (TRENDEL)

	UPPER PORTION CASES	LOWER PORTION CASES	MIDDLE PORTION CASES
Femur	157	275	138
Tibia	114	115	264
Humerus	52	22	38
Radius	1	16	28
Fibula	3	21	15
Ulna	11	19	10

The onset of the disease, so far as could be determined was more or less acute in about 60 per cent of our cases; not infrequently an exact date was given. In these cases, the history is one of a severe, sudden pain, often occurring at night, followed within a few days by swelling, redness, tenderness, and rapidly increasing body temperature, reaching often 105° F. and more. Often chills and sweating occur. At times, although not often, the onset is that of an acute infectious disease, while pain, swelling and tenderness come to the fore within two days or so. With sudden pain and swelling, and tenderness in the region of a joint and fever, the first diagnosis may readily be acute rheumatism. Indeed, Schuchardt, in his excellent monograph on diseases of bones and joints remarked that inflammation of the joint, in its early stages, may be strikingly similar to that of acute rheumatic arthritis. This may lead to error, and the error is the more easily made when the patient complains about pain in a number of joints for a day or so. When the lesion remains limited to one joint for several days, the error is soon corrected, provided that a single bone is involved. Involvement of more than one bone may extend the period of doubt as to diagnosis. In two cases, petechiae occurred; in two, abdominal symptoms were at first prominent, and peritonitis was suspected. In one case appendectomy had been performed before the patient's admission, and, although the appendix was normal, there was pus around it. In this case the symphysis was involved.

In other cases the onset is more insidious, the pain is not severe, and the other local symptoms are less pronounced. The temperature of the body may be raised little or not at all. Our mildest case was that of a boy who was five years old on admission. For one and a half years he had complained, intermittently, of pain in the right knee, that was aggravated when running around much. His general condition was good. Neither swelling nor tenderness was present. The roentgenogram gave evidence of a region of decreased density in the distal end of the shaft of the right femur. Such patients may never require surgical help, and can get well without further destruction or suppuration taking place, but a focus of infection may remain. In two other cases, a rather mild infection occurred in the course of osteomyelitis involving other bones. The first of these two cases was that of a boy, a year and a half old, who had multiple abscesses involving the left femur, and some periostitis of the right femur and of both tibias. Another boy, ten years of age, had complained of more or less pain in the right leg for two or three years. An acute exacerbation appeared for no demonstrable cause. Culture of the blood yielded staphylococci. Six years later he had some mild symptoms referable to the other leg and arm, where small lumps had formed. Both these lumps, excised completely, consisted of granulation tissue apparently not connected with the bone. But both tibia and humerus, proved on roentgenologic examination, to be the seat of osteitis. In another rather protracted case, in which there was involvement of rather low intensity, the patient was a boy, who was seven years old on admission. He had complained of having some pain in his left ankle for most of his life, in attacks of two or three days' duration. Lately, the pain had become worse, making walking difficult, and some swelling and reddening had been noted. In the lower third of the tibia an area of destruction of bone could be made out. This yielded a small amount of pus, which on culture gave a growth of staphylococci. The surgeon made a note that the condition was of that chronic type which might lead to formation of cysts. Six years later the boy returned, having had pain in the right hip for about three months. A region which gave rise to a suspicion of destruction of bone was seen at the juncture of the neck and head of the femur. The tibia was normal.

Such relatively mild cases may not be so rare as it might appear from our experience, if the data of Trendel can serve as an indication. Of 1,299 cases, in fifty-four there was no formation of pus; that is, about 4.0 per cent. Formation of pus without necrosis of bone occurred in 15 per cent of cases.

In sharp contrast to these milder cases are the quickly fatal cases. Of these we had four, that is, about 1 per cent. Two of the four patients concerned were boys, aged respectively five and thirteen

years, and two were girls, aged respectively two and four years. Death occurred from the fourth to the eighth day after the acute onset. These cases need not be considered in detail; clinically they were cases of overwhelming infection of which osteomyelitis was a part. The localizing symptoms were confined to one bone, either the femur or the tibia. The striking lesions in these cases were embolic processes in the lungs, kidneys, heart muscle, and brain. The heart valves were also affected. Purulent pericarditis, meningitis, phlebitis, gangrene of the finger tips of one hand, iritis, and bronchopneumonia were noted.

One boy, eleven years of age, who had osteomyelitis of the frontal and parietal bones, died in shock.

Other patients died after leaving the clinic. The illness of a boy nine years old, started with acute osteomyelitis of the pelvic bones and right femur. Four years later the osteomyelitis progressed to involve a clavicle and the left femur. Later in that year, osteomyelitis of the skull, and cerebellar abscess, developed. These were cared for successfully. The boy was getting along well, when, nearly one and a half years after this operation, or more than six years from the onset, he died from rapidly developing meningitis. Another boy, nine years old, when seen, had been acutely ill with multiple involvement. He died eighteen months after leaving the clinic, and we were unable to obtain further data. A girl, five years old, came under our care with extensive osteomyelitis of the left tibia and talus. Extensive surgical procedures were necessary, with a prospect of long treatment. The parents preferred to have this done at home. The child died a few months later, and again we could not secure further information. A girl, twenty-two months old, had to be taken from the clinic shortly after a cavity in the upper end of the left femur had been opened. The onset of the illness dated back thirteen months, with swelling of the thigh. The osteomyelitis was chronic. All we heard about her was that she died one month after she was taken away. A girl, nine years of age, when she was seen for extensive osteomyelitis of both sides of the lower jaw, had pus in the urine and a large, hard spleen. Twenty-two months later she died rather suddenly in a state of uremia. The case of a boy, three years of age, is of peculiar interest. He was brought to us four weeks after development of extensive osteomyelitis of the entire left tibia with a small central bone abscess, and pronounced periosteal thickening. Adequate drainage was provided. Leucocytes numbered 12,400 per cubic millimeter of blood. For the week he spent in the hospital he was afebrile. Shortly after he was taken home, the lymph nodes enlarged rapidly and greatly. The spleen became enormous. He died forty-six days after he had been taken home, from acute lymphatic leucemia.

Assuming that the osteomyelitis was in some way or other concerned in the fatal outcome in all these eleven cases, we would have a mortality of 2.8 per cent. Evidently that is a very uncertain figure. Some of our other patients may have died without our knowledge, and it is unlikely that the acute leucemia is chargeable to the osteomyelitis.

Strange to say, mortality statistics of osteomyelitis do not seem readily available. Even Trendel limited his mortality statistics to the first five years of life. On this basis, of sixty-six patients, three died, a mortality rate of 4.5 per cent.

The great majority of patients are in need of some surgical treatment, which fact will be discussed later. However, an abscess may break spontaneously and sequestrums may be cleared out in this manner. We had only ten cases without surgical intervention. In some of these ten cases operation may have been performed later. In one of the cases in which operation was not performed, an abscess due to osteomyelitis of the pelvic bones broke through the vagina of an eleven-year-old girl. She was well for a year and a half but then had trouble again. In another case in which there was involvement of several bones, including a rib, the acetabulum, the ilium, and the left and right tibias, the disease had lasted two years when the boy came to us. He was sent home in a cast with recommendation for conservative treatment; healing was reported after five years, but details were not given. The condition of another boy, twelve years old, had started acutely with involvement of both knees and ankles, and spontaneous drainage. Healing had taken place in about two and a half years, but shortly before his visit to the clinic he again had had pain following a fall. All that could be found was a fusiform swelling of the upper end of one tibia.

In a table, Trendel recorded that in about 8.9 per cent of the cases in which there was necrosis of the bone, operation was not performed.

Assuming that there was some necrosis in all of our ten cases in which operation was not performed, and, adding the previously mentioned mildest case, we would have in our list about 3 per cent of cases in which necrosis of bone was present, but operation was not performed. This does not mean that the patients can be regarded as cured.

A few words will suffice with regard to diagnosis. As is well known in the early stages, roentgenologic examination does not help. The diagnosis rests entirely on clinical examination, which now and then may perhaps be aided by cultures of urine and blood. Localization of the lesion is not always easy. For instance, in one case acute swelling and tenderness pointed to involvement of the upper end of the tibia, whereas the osteomyelitis proved later to involve the distal end.

Sometimes, if rarely, the differential diagnosis between a bone tumor and osteomyelitis has to be left until exploration can be performed. Consideration of the differential diagnosis between tuberculous and pyogenic osteomyelitis is not in our province. It is not always easy. Osteomyelitis caused by bacilli of typhoid fever (*Eberthella typhi*) seems to be as rare today as that accompanying smallpox.

The course of the disease now claims our interest, particularly with regard to its nonsurgical features. The average patient who has osteomyelitis, particularly when only one bone is involved, does not suffer much in general health as soon as the acute stage has passed. The patient becomes afebrile, and it is remarkable how rapidly the general well-being can be restored.

It is somewhat surprising that in only thirty cases, or about 8.3 per cent, noteworthy enlargement of regional lymph nodes was registered. Not infrequently, absence of this was especially noted, and at times enlargement of cervical lymph nodes was written down without mention of the regional lymph nodes. Enlargement of the spleen, also, does not belong in the usual picture. It was noted only in four instances, in one of which the enlargement receded, with improvement in the condition. In two cases enlargement of the liver was noted; in one case the liver was very large, and ascites was noted. Moderate secondary anemia is not unusual, but more severe degrees usually are reserved for the more severe cases. Depending on the stage of the disease, a greater or lesser degree of polymorphonuclear leucocytosis can be present. In none of our cases did the number of leucocytes exceed 30,000 per cubic millimeter of blood. Filament counts and sedimentation rates were determined in only a very few cases. In some of our most severe cases, the number of leucocytes was not increased at the start although we never had a case in which leucopenia was pronounced.

The urine often presents febrile albuminuria, but as soon as the febrile stage has passed, it clears. In some cases a few hyaline and granular casts are seen. But in ten cases, the urine contained, besides albumin, pus cells, and in some cases there were significant numbers of erythrocytes in the urine. Many of our patients came to us long after the acute stage was over; our time of observation of other patients was limited. In some cases which we could observe, pus appeared at times but was not present at all times. This phase of the subject deserves more attention. Cultures of urine were made in only seventeen cases; in ten the result was negative; and in seven, positive. In six of these seven cases, staphylococci were found either alone or in association with other organisms; in two cases with colon bacilli, and in two with streptococci. Only in one case were colon

bacilli found alone. It is not necessary that the urine that harbors microorganisms also contain pus. In one of our cases the culture of urine was positive several days before pus appeared, and in one case staphylococci were present for a long time without pus cells being present in noteworthy numbers.

That the presence of staphylococci in the urine may indicate a focus of infection is evident from a very interesting experience. A boy, eleven years old, whose febrile periods of a year's duration were finally attributed to Hodgkin's disease, persistently had staphylococci in his urine until an infection accompanying ingrown toe nails was treated.

In a few cases a positive culture of urine was associated with a positive blood culture. Of twenty-four cases in which blood culture was made, in six culture was positive, excluding the rapidly fatal cases. These cultures were made only in cases in which fever was rather high. Even in the very severe cases, of which we will give two examples later, the blood cultures became negative after two to three weeks. Only staphylococci were found in the blood.

In only one case did we see amyloidosis. Three girls, two nine years old, and one thirteen years old, had chorea in the spring of the same year. One of these patients had multiple involvement of bone of two years' duration. The talus of one only was diseased for two years; the ilium of the other was affected for about two months. Only in the first case did a heart murmur develop. In two cases severe bed sores developed in spite of all possible care.

In all severer cases certainly, in the milder cases preferably, there should be some supervision by a pediatrician. His function is the recognition of and care of some of the complications which may arise; he should have a vote in the determination of the risk of contemplated operation and, perhaps most important, he is to look out for adequate maintenance of nutrition, which at times is no easy task.

The disease may end in complete healing, with no impairment of function, or impairment may result. The most important forms of impairment result from involvement of joints, with limitation of motion, to complete ankylosis and changes in the length of the extremities. In fifteen of our cases, the diseased extremity was shortened, and in nine, lengthened. Trendel found forty-three cases in which lengthening occurred and thirty-three in which shortening occurred. Involvement of joints, aside from secondary, transitory involvement, was seen in sixty-seven cases, or 18.6 per cent. Trendel's corresponding figure was about 45 per cent. These lesions resulted in more or less limitation of motion. The special corrective measures demanded by these lesions are not within the scope of our discussion.

It is not uncommon for osteomyelitis to give rise to sinuses which drain for long periods; drainage for forty years and more has been reported. Of cases concerning which we could obtain information, we had nineteen in which drainage lasted from four to nine years, and of these, eleven were cases in which a single bone was involved.

With regard to healing, it must be kept in mind that after months, and even years, a flare-up may occur, sometimes for no determinable cause, often after some injury. The flare-up may involve the original site, another part of the same bone, or another bone. The majority of observers are of the opinion that no new infection takes place, but that an old "sleeping" infection becomes active. But if bacteriologic examinations, comparing microorganisms found in earlier and in later attacks, have been made, reports of them have escaped our notice. For instance, a lesion of osteomyelitis of the radius seemed to be healed for eighteen months, when it broke open again. A lesion of osteomyelitis of the tibia was healed for sixteen months, but about three years later the femur became involved. In one case of acute osteomyelitis of the humerus healing occurred, but the patient returned after five years with acute osteomyelitis of the tibia; this also was reported to have healed when the patient was heard from after more than three and a half years. In one case a radical operation on the tibia became necessary after four and a half years of drainage; healing was reported four and a half years after the operation. In another case, in which a lesion of osteomyelitis of the tibia had not healed after ten years, complete healing was reported after a total of twelve and a half years.

TABLE IV

HEALING OF LESIONS OF OSTEOMYELITIS INVOLVING SINGLE BONES OF CHILDREN IN RELATION TO EARLY AND LATE SURGICAL OPERATION

	OPERATION BEFORE END OF THREE WEEKS FROM ONSET (71 CASES)		OPERATION AFTER THIRD WEEK FROM ONSET (26 CASES)	
	CASES	PER CENT	CASES	PER CENT
Healed	42	59.2	15	57.6
Not healed	29	40.8	11	38.2

In Table IV we recorded cases in which healing occurred and cases in which there was no healing, so far as we could obtain sufficient information for tabulation. The aim was to determine the relationship of healing to early surgical interference, and we considered operation before the end of three weeks to be early interference. This sort of tabulation could be made only for cases in which a single bone was involved. In Table V, also, we recorded cases in which healing occurred and cases in which it did not occur, but, in this table, we paid attention to the relationship of healing to involvement of a single

TABLE V

HEALING OF LESIONS OF OSTEOMYELITIS OF CHILDREN IN RELATION TO INVOLVEMENT OF ONE BONE OR MORE THAN ONE

	INVOLVEMENT OF A SINGLE BONE (97 CASES)		INVOLVEMENT OF MORE THAN ONE BONE (26 CASES)	
	CASES	PER CENT	CASES	PER CENT
Healed	57	58.7	10	38.5
Not healed	40	41.3	16	61.5

bone or of several bones. The result was rather astonishing; early operations did not seem to have given very much better results than late operations. We do not lay much stress on these figures. The operative procedures often had been carried out long before the patients came to us, and the number of cases we could utilize for tabulation was much too small to allow definite conclusions to be reached. But we do wish to emphasize the necessity for further information. The chances of healing in cases of multiple involvement seem to be smaller than when involvement is of a single bone, but how great is the difference must also be left for further study to determine.

If there is one thing which is outstanding in our study, we think it is that treatment in a large number of cases of osteomyelitis is unsatisfactory, and that there are problems in this field well worthy of the combined study of surgeon and pediatrician.

SURGICAL TREATMENT

Surgical operation probably is indicated at some stage in nearly every case of osteomyelitis. Although in a few cases the process may go on to spontaneous healing, without operation, the fact remains that the great majority of all cases of osteomyelitis must be regarded as surgical. In the literature of the past few years the surgical treatment has been somewhat overshadowed by the use of accessory substances such as maggots, bacteriophage, and so forth—this in spite of the fact that nearly all well-qualified observers have stressed the importance of adequate operation no matter what sort of adjunct is used.

Probably no author on this continent has received such widespread recognition of his attitude toward treatment of acute osteomyelitis as has Starr,[12] particularly in cases in which the lesion probably is localized in the metaphysis of the long bones. He expressed the belief that treatment should consist of an incision over the region of greatest tenderness and that the incision should be continued through the skin, subcutaneous tissue, and periosteum. Care should be taken, he said, to preserve the periosteal attachment to the epiphyseal line, and the incision should be made on the diaphyseal side of the epiphyseal line. If frank pus is encountered beneath the periosteum, the incision should be sufficient and a drain inserted. If no gross pus is found, the

periosteum should be stripped for a short distance on each side of the incision and a series of drill holes made toward, but not into, the epiphysis. Starr did not open the medullary cavity and considered opening it to be a dangerous procedure. When a patient is seen in the later stages of the disease, efficient drainage should be established, but until a sequestrum can be removed no extensive decortication should be done. After a sequestrum has formed, it should be removed through an opening that penetrates the involucrum, and that is of sufficient size to allow the sequestrum to be removed. The cavity should be cleaned of dirty granulations, sponged with iodine, and packed tightly with iodoform gauze for forty-eight hours. After the packing and drains have been removed, if the remaining cavity is too large to fill easily with granulation, the edges should be made saucer-shaped, and should be allowed to fall in and obliterate the cavity.

The foregoing is taken almost word for word from the nineteenth report of *Progress of Orthopedic Surgery*. The editors at that time agreed with Starr. The same ideas have been expressed by Robertson,[9] Platt,[7] and Rost.[10] The last frankly stated that he thought opening the bone in the presence of a subperiosteal abscess would be dangerous. Krasnobaew reviewed 600 cases, 428 of which were acute. From study of these, he concluded that among other things it is of greatest importance to consider the general condition of the patient and that too radical treatment in the first stage is not only useless but dangerous. These and other observations were more or less along the same line as those of Starr and seem to bear out the opinion held by most physicians who have successfully treated the disease; namely, that a happy medium should be struck between the more radical and the more conservative practices.

By and large it should be pointed out that in the presence of an acute, fulminating type of disease, and infection of the blood stream, operation should be resorted to only when the indications are clear-cut and precise. When the pain and tenderness are definitely localized, incision is indicated; and if pus is encountered beneath the periosteum, opening of the bone is not necessary at once. It may be found necessary, in two or three days, to open the bone, but little harm can come from the delay in most cases, and in many cases the marrow cavity will be spared almost certain infection. Roentgenograms must not be relied on at all for aid in acute cases. In the more chronic stages, roentgenograms are of the utmost importance.

In many cases, hope cannot be entertained of opening up the entire infected region; subsequent roentgenograms will reveal a much more extensive change in the bone than is suspected at first sight. Opening the marrow cavity is indicated only when pus is not encountered beneath the periosteum, but a drill hole reveals pus. We believe that more than a drill hole should be made in case pus is encountered.

Surgical treatment for the later stages consists of three procedures, as they may be indicated. 1. Sequestrums should be removed if this is indicated, and the indications are two: first, persistence of symptoms with or without a draining sinus, and second, the presence of a sequestrum as demonstrated by roentgenograms. 2. Sinuses of soft parts should be curetted in cases in which, otherwise, nothing of importance can be demonstrated. Occasionally, on examination, these curettings will be found to consist of tuberculous tissue, and occasionally a small spicule of sequestrum may be found to be keeping up the drainage. 3. More or less extensive excavation of the bone shaft, in the form of a saucer, should be carried out in cases of widespread infection of cancellous and cortical bone. This procedure is one that has been advocated for years, and when carefully done and followed up, in many cases is of value. However, its abuse is probably as frequent as its proper use.

The choice of proper dressings after operation is important. Of late years, advocates of various substances, such as vaseline gauze, maggots, maggot extract, and so forth have reported varying results. As to the relative merits of all of these substances we have little to say from personal experience. Our own method has been thorough cleansing of the bone cavity with iodine and packing with vaseline gauze, according to Orr.[5] This packing is changed at intervals of approximately one week to avoid the disturbing malodor that always is present in these cases. Only in cases in which extensive involvement of bone has threatened to result in pathologic fracture, have we used plaster-of-Paris casts.

The use of maggots, as advocated by Baer,[1] has had enough trial to have produced something in the way of definite conclusions regarding its value. There seems to be a pretty well-established opinion that good surgery must precede their use, and that maggots do not destroy dead bone or bacteria. The successful propagation and supply of maggots are attended with difficulty, and their use on many patients is objectionable to the patients themselves and to other patients in the ward.

The use of bacteriophage has been recommended by some, but many have tried it and have failed to be convinced of its value in osteomyelitis. Dakin's solution was so widely used during the World War that its future seemed assured. However, it is comparatively rarely used now, and mainly because of the difficult and elaborate technic necessary to carry on its use, not to mention the discomfort to the patient of daily dressings.

In the more severe infections of the blood stream, nothing is more useful than blood transfusion. Transfusions every day, or every other day during the active infection, will do more to build up resistance

on the part of the patient than any other type of treatment. Immunotransfusions and reconvalescent serum have been recommended but have not been tried sufficiently. The various dyes recommended have been tried from time to time without conclusive proof that they help. Gentian violet, mercurochrome, and metaphen all have been used by us without consistently good results.

Résumés of four cases are given to illustrate the necessity of close cooperation of internist and surgeon.

REPORT OF CASES

Case 1.—A girl, nine months old, had had an infection of the upper part of the respiratory tract for two days, with a temperature of 103° F. Then swelling and tenderness of the right knee had appeared, and the temperature rose to 104° F. On the fifth day after onset of the condition an incision was made above the knee, pus was seen, and the metaphysis was drilled. On the twelfth day after operation, the temperature became normal and the patient was dismissed. She was brought back after three days with swelling of the right thigh. This was incised. Four days later, erysipelas spread over the entire body. She was in hospital seventy-six days when she was treated with erysipelas antistreptococci serum, transfusion, ultraviolet rays, roentgen rays, injections of glucose, and tube feeding. At times the girl was extremely ill and was difficult to feed. During her stay in hospital bilateral suppurative otitis media developed; also, abscesses of the left thigh, left sacral region, region of the right knee, and dorsum of right foot developed, and bulbous impetigo appeared on the head. The only involvement of bone was in the middle of the left femur. The lowest value for hemoglobin was 40 per cent; the number of erythrocytes dropped to 2,500,000; and the number of leucocytes varied from 9,000 to 25,000 per cubic millimeter of blood. The percentage of polymorphonuclear cells was as high as 89.5; the count of nonfilamented cells exceeded the count of filamented cells somewhat. The urine remained practically negative throughout. For a short time it contained some bile pigment (methylene blue test). From the pus from the ears, staphylococci were grown, and from the incision in the left thigh, hemolytic streptococci.

Case 2.—A girl, aged seven years, had had sudden pain in the right ankle. In the next few days, there was swelling, redness, and tenderness, and the temperature was from 103° to 104° F. On the fourth day, an incision was made over the lower part of the tibia and purulent material drained forth. Drill holes were made in the lower part of the tibia, but no pus appeared. Pus was found in the ankle joint. The talus was exposed and was seen to be discolored. A culture from the wound contained staphylococci. Blood cultures were negative. Extensive osteomyelitis of the talus was present. In the next year, several times, incision, curettage, and sequestrectomy were performed. Drainage continued. The girl had chickenpox, measles, several attacks probably of slight appendicitis, and several attacks of pharyngitis. About three years after onset of the osteomyelitis she had chorea. Her condition improved with rest. Thorough cleaning of the whole sinus and cavity of the talus was decided on. The foot was put in good walking position, casts were applied, and provision for drainage was made. She was sent to Florida. Complete cure resulted, with ankylosis of the ankle. Hardly noticeable atrophy and shortening of the leg remained. The girl is active in sports.

CASE 3.—A girl, seven years old, had a temperature of 105° F. Some swelling of the upper part of the right arm appeared. The joints were free. Leucocytes numbered 6,600 per cubic millimeter of blood, with 83 per cent polymorphonuclear cells. On the third day after onset, the humerus was drilled at the upper metaphysis. Leucocytes ranged in number from 8,000 to 29,000 per cubic millimeter of blood. The temperature, for eight days, was up to 105° F., then it became more remittent, ranging up to 102° F. and occasionally to 103.5° F., and finally it became normal. During her stay in hospital, there were superficial areas of reddening and swelling of various parts of the skin, some with formation of pus, and healing with or without incision. Bilateral pleurisy and bronchopneumonia developed, together with pericarditis fibrinosa, pyelonephritis, oliguria, general edema, and ascites. Enlargement of the liver and questionable peritoneal involvement also appeared. Treatment consisted in blood transfusion, with and without gentian violet, and pericardectomy. The right humerus, right and left metatarsals, and right fibula were involved. In cultures of blood and of urine and in some material from the pericardium, staphylococci were found. The last positive blood culture was obtained about the seventeenth day after admission. For about a year, the patient's general condition was very good. There was some drainage from the left foot and right ankle. During the year following this, abscesses of the right foot, right leg, and left foot were drained. Tonsillectomy and adenoidectomy were performed, and thick pus was obtained from the upper pole of the right tonsil. Chorea was present, and a systolic murmur, transmitted to the axilla. The urine was negative, and during this year radical operation was performed on the right fibula. The year after the chorea had occurred, the systolic murmur had disappeared. Seven and a half years after the patient's admission, the right humerus, right fibula, metatarsals, right femur, right ilium, right acetabulum, neck of the left femur and left ilium were involved. The patient underwent various operations in all this time, mostly consisting of draining of abscesses and application of casts. The last renal flare-up was about six years after admission. The patient walks with a brace, and flexion deformity of the right hip is present. Two small sinuses are draining, and she limps. There is shortening of the leg of about 3 cm. The girl's general condition is very good. Observation has extended for eight years.

CASE 4.—A boy, twelve years old, ten days before admission had a boil over his left patella. During the ten days, this region was struck twice with a baseball; then he had severe pain in the left groin. He had fever next day, and increasing malaise, loss of appetite, vomiting, and delirium. Roentgenograms were negative, and on entrance the boy's temperature was 106° F. He was in hospital 194 days, and always was febrile. During this time, he had empyema of the right side of the thorax and fluid in the left side of the thorax. A roentgenogram gave evidence of multiple abscesses of both lungs. The left hip, left femur, and right acetabulum were involved. Destructive arthritis of the lateral articulations of the fifth and sixth cervical vertebrae was present. The right clavicle, a rib, right ankle, right thumb, right elbow and left elbow were involved. Deep and extensive bed sores appeared. One time he had a convulsion, with a few minutes of unconsciousness, but he completely recovered from this. The kidneys became involved. When he was leaving the hospital the empyema still was under treatment. The condition of the skin improved. The left hip was regarded as the main site of the disease. During the first half month, staphylococci grew on blood culture. Incisions were made in the left hip, ankle, elbow, and right hip. Four transfusions of blood and one immunotransfusion were given. Gentian violet was injected. Staphylococci appeared in the urine before pus appeared. On the patient's dismissal, the urine was clear; cultures were negative. The boy was seen several times at home after

leaving hospital. About three years later amyloidosis appeared. Treatment with liver was not successful. The left hip became ankylosed. He had draining sinuses in the right thigh, left thigh, sacroiliac region, clavicle, elbow, and foot. There was extensive involvement in the region of the pelvic bones. Observation extended for four years.

SUMMARY AND CONCLUSIONS

The primary object of this paper is to invite further study in the field of osteomyelitis. Cultures of blood, urine, and wounds should be made whenever possible. In order to arrive at a better estimate of the patient's general condition, close cooperation of surgeon and internist is of advantage. This is often necessary for adequate treatment. It is imperative to obtain better data with regard to the ultimate results of various therapeutic procedures.

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STANDARDS OF PHYSICAL DEVELOPMENT FOR REFERENCE IN CLINICAL APPRAISEMENT*

Suggestions for Their Presentation and Use

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THERE are two primary purposes for which measurements are commonly taken by pediatricians and compared with standards of physical development. The first is in connection with research projects which deal with differences between groups of children, as for example, differences due to age, sex, race, and type of body build, and studies of the effects upon growth of differences in diet, activity, environment, and disease. It is generally conceded that for these research purposes all figures should be subjected to certain statistical procedures and that a working knowledge of modern biometric technic is required for the interpretation of group differences. The second purpose in using measurements is to assist in the evaluation of individual children and in the detection of faulty development. Measurements chosen for these clinical purposes must be few in number, obtained with reasonable accuracy by simple devices, and subject to interpretation without undue mathemathical complexity. It is also important that the standards used show in proper perspective the attributes of individual measures and throw into relief significant rather than unimportant or unreal features. It is the purpose of this paper to consider this clinical use of anthropometric data, particularly the way they may be thought of and compared with clinical judgments for most useful conclusions.

The simplified standards or rules of thumb formerly adopted for clinical use in examining children have, for the most part, proved too inaccurate for real discrimination. Among the many attempts to refine them and make them more serviceable, the use of indices based upon the relation of two or more measurements to each other has received the greatest attention. These have their uses, particularly in the sorting out of different classes of children by clinically inexperienced per-

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*Most of the measurements presented in this paper have been taken and tabulated by Vernette Vickers, B.Ed., and Constance Shaw, B.S.S., in connection with a more comprehensive study of growth and development being conducted by the Department of Child Hygiene. They will be reported in greater detail when the series has been completed.

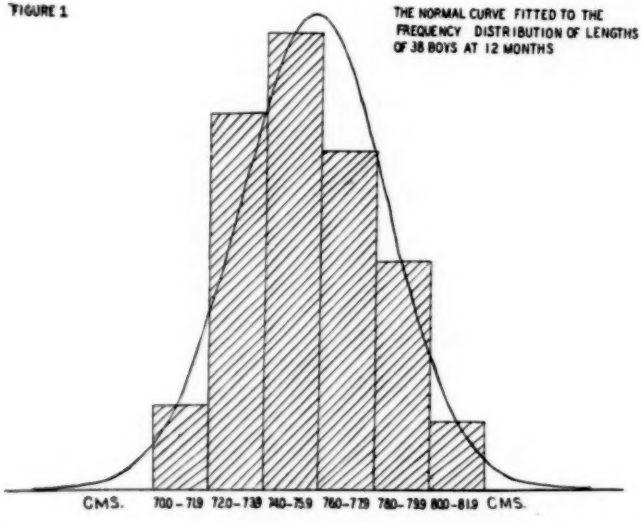
sons. Many of them seem very abstract and impractical. For pediatricians or those clinically trained and experienced in the examination of children, the time spent arriving at the mathematical expression of a relationship would often seem better spent in making direct comparisons, one measurement with another, and each with clinical observations and with the child's history. What seems most needed is some simple method of assembling and presenting in reasonably comparable form, data derived from different sources and by different technics. One would like to have the main features of this data visualized, or at least as free from figures and unessential details as possible. Measurements should be used to reinforce and improve clinical judgments, not to replace them. They should fit in logically with clinical methods of thought, for their usefulness is in large measure dependent upon the way in which they are analyzed and interpreted.

The clinician is constantly comparing one child with a composite picture of children of similar age. This picture includes a wide range of variations which he has come to expect on the basis of experience. The way any one physician will interpret a child will depend both upon the accuracy of his observations and upon the extent and type of his personal experience. The physician uses measurements primarily to confirm or refute his impressions of size and proportion and to call attention to unusual features which he has overlooked; in short to assist in making his interpretations as objective as possible. Norms should therefore be so assembled and presented as to allow direct comparison between subjective ratings and the implications of measurements. Since the consideration of an individual's relation to the usual range of occurrences offers a most helpful approach to an understanding of him and since all measurable attributes show wide variations at any given age, it would seem most helpful if norms made it possible to determine the place an individual holds in relation to the usual distribution of measurements. One should also be able through the use of norms to compare a child's rank in one measurement with that in another. The interpretation to be placed on any one measurement depends to a considerable extent upon the general position of others. One also wishes to be able to compare a child's position at one time with previous periods, to see whether his progress has been satisfactory.

Any single figure chosen to represent the standard or usual measure of an attribute unduly emphasizes one point in a range and attaches to it a suggestion of normality not shared by other figures. Experience with the average weight figure in the use of height-weight-age tables is a notable example. The estimation of the percentage of deviation from this average is a crude attempt to measure the degree of variation which the individual exhibits, but the figure obtained is meaningless

unless one remembers the frequency with which different deviations are normally found. Furthermore, negative deviations inevitably carry with them the implication of inferiority. One can introduce the concept of "range" by giving the two figures which supposedly limit normal findings. However, the actual ranges found in large series include such extreme and unusual deviations that it becomes necessary, if they are to have practical significance, to include only those figures which are of fairly common occurrence. Faber[1] has prepared modifications of the height-weight-age tables which give the range rather than the average, but his tables eliminate the top and bottom 10 per cent from each group as too unusual to be included. These tables are undoubtedly more use-

FIGURE 1



ful than those giving averages, but they do not indicate, except in the extremes, how common or how unusual a specific measurement really is.

There are various methods of setting up standards based upon measurements obtained on large groups of comparable children, by which the frequency of occurrence of particular measurements may be shown. One method is to lay off columns representing given intervals of measurements and indicating in each column the number of children falling in that particular interval. This is the method usually adopted in the reports of the Children's Bureau and used by Eliot[2] in her recent report on Porto Rican children. Interpretation of these tables involves a comparison of a series of different numbers, a disadvantage which may be avoided by plotting the numbers under each measure as a graph. Fig.

1 shows the lengths of the one-year-old boys in our series plotted by intervals and fitted to a hypothetical "normal distribution curve." Measurements are only a means to an end, and we wish, as quickly as possible after taking them, to forget the actual figures and to think rather of their implications. When using a graphic representation of a distribution of figures, as a norm or standard of reference, we focus attention upon the position which a particular child adopts in relation to a standard group and upon the number of children like him, rather than upon the measurement itself. It is, however, cumbersome to deal with graphs and preferable to use some expression to show these relationships. One way is to use the mean (average) and the standard deviations (sigmas) from this mean. The position of the mean and one to three positive and negative standard deviations are indicated in a "normal distribution curve" in Fig. 2. This method of expression is generally conceded to be most useful in research projects, in dealing with figures which have a relatively "normal" or symmetrical distribution, and is the method adopted by Gray and Ayres.[3]

Another method of expressing position in a distribution is to use the percentile scale. This can be applied to any set of figures regardless of whether or not they follow closely a "normal" distribution. Under this system the number of cases in any series is divided into succeeding percentage divisions according to increasing measurements. The 25 percentile (first quartile) indicates that 25 per cent or one-quarter of the measurements fall below and three-quarters above this figure. The 50 percentile is the median of the group, which means that an equal number fall below and above this figure. Similarly half of the cases fall within the range limited by the 25 and 75 percentiles. A very simple and practical scale uses the 10, 25, 50, 75, and 90 percentiles, thus dividing any series into six intervals or ranks: under 10, 10 to 25, 25 to 50, 50 to 75, 75 to 90, and over 90. These divisions of a "normal distribution curve" are shown in Fig. 3. When norms are distributed in this way, one may readily place any child in one of the six ranks in respect to each of the measurements taken. This scale has been adopted for reporting our measurements in the tables and figures which follow, although in plotting the growth curves of individual children we have used the smaller 5 per cent ranks for purposes of more detailed study. For clinical use more accurate placement than in one of the six ranks shown in our norms hardly seems justified by knowledge of the significance of measurable differences. All a physician is really interested in is to determine about where a particular child would stand if lined up with a healthy group of comparable children in ascending order of magnitude, first of one measure and then of another, and to be able to

FIGURE 2

NORMAL CURVE
SHOWING MEAN AND STANDARD
DEVIATIONS

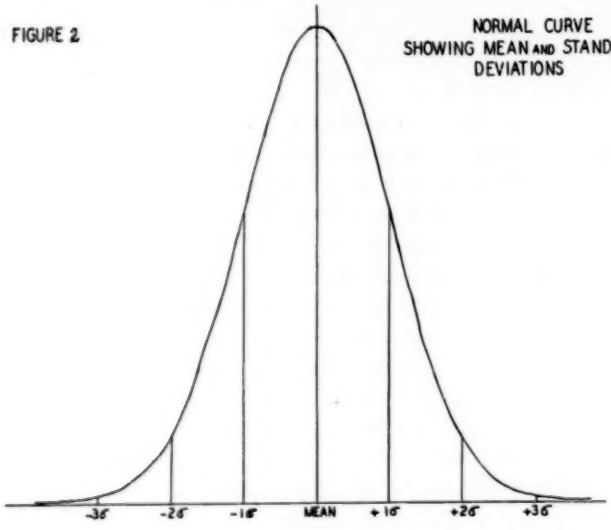
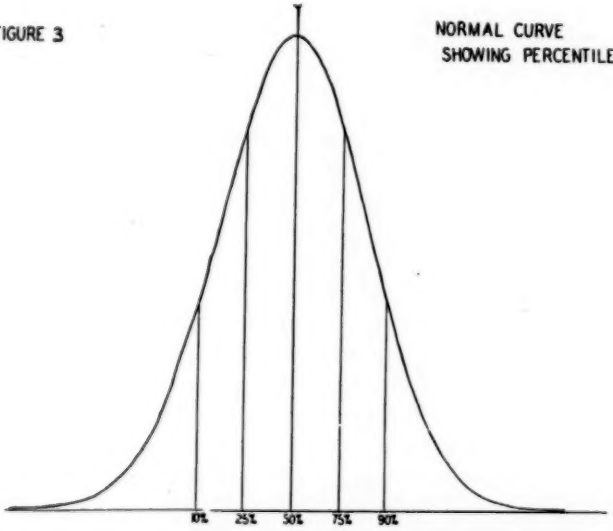


FIGURE 3

NORMAL CURVE
SHOWING PERCENTILES



Figs. 2 and 3.—The type of curve which is closely approximated by plotting measurements of normal individuals although most measurements produce slightly asymmetrical curves. Fig. 2 indicates the segments of the distribution included between various sigma values, and Fig. 3, the segments included between various percentile values. In perfectly normal distributions the mean and the median are seen to be the same and to fall at the height of the curve, but the sigma lines include different proportions of the total from the percentiles. The range of plus and minus one sigma includes 67 per cent and plus or minus two sigma, 95 per cent.

make comparisons between the different positions adopted. It makes no difference which method one uses for expressing this position provided it is sufficiently accurate and provided one understands what the expression means. Position expressed in percentile rank would seem to be more readily understood and to be a more familiar concept for physicians than when expressed in terms of standard deviations. It clearly indicates the position a child holds in relation to his group. This is the information which is desired in the interpretation of his status, and it is the maintenance of this position or the recognition of shifts in position over intervals of time which one wishes to recognize in the observation of progress. Given norms distributed in percentile ranks for all common measurements for each sex at each successive age one would be in a position to gain a number of useful impressions regarding the physical characteristics of a particular child by measuring him and relating his measures to these scales. The physician could then record his subjective evaluations in a way which would allow rough comparison with these objective findings.

Another advantage of thus focusing attention upon the implications of figures rather than the figures themselves, is that in considering progress from period to period the actual measurements used do not have to remain the same. For example, if one is following the progress of a child from infancy onward, he must use recumbent length in the early years but would prefer to use standing height or stature in the later years. When curves are plotted on the basis of actual measures, the shift from recumbent length to stature destroys the significance of the curve. If, however, the place in the percentile distribution is being followed, one may legitimately use recumbent length at one period and stature at another and compare the place of the two in relation to the distribution of each as found in groups of comparable children. In mental testing, for example, one would not think of applying the same test to a one-year-old child as to a school child, and if this were a requirement, no comparisons could be made. Measurements other than weight are notably difficult to obtain accurately during the first three years of life, and many of the measurements adopted for standard use by anthropologists are totally inapplicable during these years. The International Agreement[4] as to the technic to be used in measuring man totally ignores the difficulties of measuring during the years of noncooperation. It is therefore necessary in measuring infants to depart from these standard technics, and in the absence of generally accepted technics to work out measurements of one's own.

The group connected with the growth study at the Harvard School of Public Health are, among other things, involved in the consecutive measurement of children during the early years and are trying to answer

TABLE I

NORMS FOR DIRECT MEASUREMENTS—BOYS

MEASUREMENT	AGE	NO.	SMALLEST	MEDIAN AND PERCENTILES					LARGEST	MEAN AND ± 1 σ		
				10%	25%	50%	75%	90%		MEAN	1 σ	RANGE OF ± 1 σ
Head circumference	Birth	50	32.4	33.7	34.5	35.4	36.0	37.3	38.0	35.4	1.3	34.1-36.7
	2 wk.	33	33.9	35.0	35.5	36.3	37.0	37.9	38.2	36.3	1.2	35.1-37.5
	3 mo.	50	38.6	39.2	40.1	41.0	41.8	42.7	44.0	41.0	1.3	39.7-42.3
	6 mo.	45	41.8	42.5	43.3	44.2	45.0	45.7	46.0	44.9	1.1	43.8-46.0
	9 mo.	41	43.6	44.4	45.1	46.1	46.7	47.4	48.4	46.0	1.1	44.9-47.1
	12 mo.	37	45.1	45.6	46.5	47.3	47.9	48.6	49.3	47.2	1.0	46.2-48.2
	18 mo.	34	47.0	47.4	48.1	48.9	49.8	50.9	51.2	49.1	1.2	47.9-50.3
	24 mo.	26	47.8	48.2	49.1	50.1	50.9	51.7	52.0	50.0	1.3	48.7-51.3
Chest circumference	Birth	50	29.2	30.6	31.6	32.9	34.5	35.8	37.0	33.1	1.9	31.2-35.0
	2 wk.	34	30.0	31.6	32.7	33.7	34.9	37.2	38.0	34.0	1.9	32.1-35.9
	3 mo.	50	37.0	38.8	39.5	40.7	41.7	43.5	44.2	40.8	1.7	39.1-42.5
	6 mo.	45	40.4	42.1	42.9	44.3	45.9	47.2	50.2	45.5	2.0	43.5-47.5
	9 mo.	42	42.0	43.7	45.0	45.9	48.1	49.9	51.6	46.6	2.2	44.4-48.8
	12 mo.	38	42.3	44.9	46.5	47.6	49.2	51.1	52.0	47.8	2.3	45.5-50.1
	18 mo.	34	45.8	47.1	48.1	49.5	51.4	52.8	54.0	49.6	2.5	47.1-52.1
	24 mo.	26	48.2	48.9	49.9	50.9	52.3	54.2	55.7	51.2	1.8	49.4-53.0
Interspinous	Birth	50	6.9	7.3	7.7	8.1	8.4	8.9	9.5	8.1	0.6	7.5- 8.7
	2 wk.	34	7.2	7.5	7.8	8.2	8.5	9.2	9.5	8.2	0.6	7.6- 8.8
	3 mo.	50	8.7	9.6	9.9	10.3	10.8	11.2	11.4	10.4	0.6	9.8-11.0
	6 mo.	45	10.0	10.5	11.0	11.4	11.8	12.3	13.2	11.9	0.7	11.2-12.6
	9 mo.	42	10.8	11.2	11.6	12.0	12.4	12.9	13.4	12.0	0.6	11.4-12.6
	12 mo.	38	11.2	11.5	11.9	12.4	12.9	13.4	14.5	12.4	0.8	11.6-13.2
	18 mo.	34	12.2	12.7	13.1	13.3	13.7	14.3	15.0	13.4	0.6	12.8-14.0
	24 mo.	26	13.1	13.2	13.6	13.9	14.4	15.2	15.4	14.1	0.6	13.5-14.7
Length	Birth	50	45.0	47.7	49.2	50.7	52.2	52.9	54.4	50.5	2.1	48.4-52.6
	2 wk.	33	47.0	49.2	51.1	52.3	53.5	54.7	55.6	52.1	2.0	50.1-54.1
	3 mo.	50	57.2	58.2	59.1	60.6	62.2	63.5	66.4	60.8	2.0	58.8-62.8
	6 mo.	44	62.3	64.4	65.6	66.9	69.0	70.2	70.5	67.1	2.0	65.1-69.1
	9 mo.	42	68.0	68.8	70.1	71.2	73.0	74.9	76.0	71.5	2.1	69.4-73.6
	12 mo.	38	71.8	72.4	73.7	75.5	77.6	79.4	81.1	75.7	2.6	73.1-78.3
	18 mo.	34	78.9	79.1	80.5	82.2	83.9	85.5	90.0	82.4	2.6	79.8-85.0
	24 mo.	26	83.5	84.6	86.2	88.9	90.4	91.7	96.7	88.5	2.8	85.7-91.3
Weight	Birth	50	5- 6	6- 4	6-15	7- 8	8- 3	9- 6	10-11	7-10	1- 2	6- 8- 8-12
	2 wk.	52	5-14	6- 5	17- 0	7- 9	8- 1	9- 0	10- 9	7-10	1- 0	6-10- 8-10
	3 mo.	51	10- 6	10-14	11-12	12-10	13-12	15- 0	17- 2	12-14	1-11	11- 3-14- 9
	6 mo.	44	12-12	15- 2	15-14	7- 0	18- 3	19- 2	22-10	17- 1	1-12	15- 5-18-13
	9 mo.	42	16- 0	17- 3	19- 0	19-14	21- 9	22-11	24- 0	20- 1	2- 0	18- 1-22- 1
	12 mo.	38	18- 0	19- 2	20- 9	22- 0	23-10	25- 4	28- 7	22- 3	2- 6	19-13-24- 9
	18 mo.	34	20- 9	21-11	23-12	25- 2	26-11	28- 6	31- 8	25- 2	2- 6	22-12-27- 8
	24 mo.	26	23-14	25- 9	26- 8	27- 9	29-11	32- 6	35- 5	28- 3	2- 9	25-10-30-12

Footnote to Tables I and II: All measurements reported at consecutive age periods have been taken on the same group of children, sick or clinically abnormal children having been excluded. Only white children (of American or North European parentage), weighing over 5 pounds at birth and receiving reasonably good feeding and care have been included. Birth refers to measurements taken within the first forty-eight hours, and all subsequent measurements have been taken within one week of the age specified. The two weeks' examination is done on the twelfth, thirteenth, or fourteenth day. Various members of the study staff have measured at birth, but there has been consistency of observers at later ages. All children are measured by two observers at each examination. If the measurements agree within 0.5 cm., the median is taken. If there is a discrepancy of more than 0.5 cm., a second reading by each measurer is required, and the median of the total measurements is recorded. All measurements are taken with the child stripped and lying on a table, and, excepting at the lying-in period, between 2 and 4 in the afternoon. Lengths are taken with a Martin anthropometer attached at its base to a specially devised metal plane which guarantees a fixed right angle between it-

TABLE II

NORMS FOR DIRECT MEASUREMENTS—GIRLS

MEASUREMENT	AGE	NO.	SMALLEST	MEDIAN AND PERCENTILES					LARGEST	MEAN AND ± 1 σ		
				10%	25%	50%	75%	90%		MEAN	1 σ	RANGE OF ± 1 σ
Head circumference	Birth	63	31.2	33.1	33.7	34.7	35.5	36.0	37.0	34.4	1.4	33.0-35.8
	2 wk.	50	32.8	33.7	34.6	35.6	36.5	37.2	38.0	35.5	1.2	34.3-36.7
	3 mo.	69	38.2	38.5	39.1	40.2	41.1	41.8	42.6	40.2	1.2	39.0-41.4
	6 mo.	57	41.0	41.4	42.1	43.0	43.9	44.8	46.2	43.1	1.3	41.8-44.4
	9 mo.	54	42.3	42.9	43.8	44.7	45.8	46.8	47.9	44.8	1.4	43.4-46.2
	12 mo.	48	43.6	44.1	44.9	45.9	46.9	47.9	49.1	46.0	1.4	44.6-47.4
	18 mo.	44	44.8	45.7	46.4	47.3	48.3	49.5	50.1	47.4	1.4	46.0-48.8
	24 mo.	30	46.2	46.5	47.2	48.0	49.2	50.0	50.5	48.2	1.3	46.9-49.5
Chest circumference	Birth	63	29.9	30.4	31.5	32.8	34.1	34.9	37.0	32.8	1.8	31.0-34.6
	2 wk.	50	30.0	31.0	32.4	33.9	34.8	35.6	36.5	33.5	1.6	31.9-35.1
	3 mo.	69	35.4	38.0	38.8	40.2	41.1	42.7	45.5	40.2	1.8	38.4-42.0
	6 mo.	58	38.3	41.1	42.4	43.5	45.0	45.7	49.2	43.5	1.9	41.6-45.4
	9 mo.	54	41.8	43.1	44.6	45.7	46.9	47.8	50.4	45.6	1.2	44.4-46.8
	12 mo.	49	43.2	44.7	46.3	47.7	48.5	49.5	52.2	47.5	1.9	45.6-49.4
	18 mo.	44	45.0	46.4	48.0	49.5	50.8	51.9	53.2	49.4	2.0	47.4-51.4
	24 mo.	31	45.4	48.6	49.5	50.7	52.4	54.3	54.6	50.9	2.2	48.7-53.1
Interspinous	Birth	63	6.4	7.1	7.4	7.9	8.3	8.5	8.9	7.8	0.5	7.3- 8.3
	2 wk.	50	7.0	7.5	7.7	8.1	8.5	9.0	9.8	8.2	0.6	7.6- 8.8
	3 mo.	68	8.9	9.5	9.8	10.2	10.5	11.0	11.8	10.2	0.7	9.5-10.9
	6 mo.	58	10.2	10.3	10.7	11.2	11.6	12.0	13.1	11.2	0.6	10.6-11.8
	9 mo.	54	10.6	11.1	11.3	11.8	12.3	12.7	13.9	11.9	0.7	11.2-12.6
	12 mo.	48	10.8	11.3	11.9	12.4	12.9	13.3	14.0	12.4	0.8	11.6-13.2
	18 mo.	44	11.6	12.1	12.4	13.1	13.4	13.9	14.4	13.1	0.7	12.4-13.8
	24 mo.	29	11.9	12.7	13.4	13.9	14.3	14.7	15.4	13.8	0.8	13.0-14.6
Length	Birth	63	45.6	47.2	48.8	50.1	51.0	52.2	55.6	50.0	2.0	48.0-52.0
	2 wk.	50	46.8	48.5	49.9	51.5	52.8	54.0	58.6	51.5	2.3	49.2-53.8
	3 mo.	69	54.4	56.4	57.8	59.6	60.7	61.8	65.0	59.2	2.0	57.2-61.2
	6 mo.	58	59.4	62.4	63.8	65.5	66.8	68.2	69.8	65.3	2.1	63.2-67.4
	9 mo.	54	64.8	67.0	68.4	69.8	71.8	73.2	75.0	70.0	2.2	67.8-72.2
	12 mo.	49	68.6	70.3	72.3	73.6	75.8	77.8	79.0	73.9	2.6	71.3-76.5
	18 mo.	44	74.0	77.6	79.5	81.2	83.1	85.0	87.0	81.2	2.8	78.4-84.0
	24 mo.	31	80.0	82.0	84.6	85.9	88.1	89.7	92.2	86.1	2.9	83.2-89.0
Weight	Birth	63	5- 9	6- 0	6-11	7- 8	8- 3	8-11	8-14	7- 7	1- 0	6- 7- 8- 7
	2 wk.	66	5- 6	5-10	6- 6	7- 6	8- 3	8-11	9-11	7- 5	1- 1	6- 4- 8- 6
	3 mo.	69	9- 5	10- 5	11- 6	12- 4	13- 0	13-13	16- 2	12- 3	1- 6	10-13-13- 9
	6 mo.	58	12- 0	14- 4	15- 5	16- 0	17- 5	18- 8	23-10	16- 5	1-13	14- 8-18- 2
	9 mo.	53	14- 4	16- 9	17-10	18-15	20- 7	22-10	25-14	19- 4	1-14	17- 6-21- 2
	12 mo.	47	16- 2	18- 3	20- 3	21-10	23- 6	25- 5	28-12	21-13	2- 9	19- 4-24- 6
	18 mo.	44	18-15	22- 0	23- 0	24- 9	25-14	29-12	32- 0	24-15	3- 0	21-15-27-15
	24 mo.	31	20-12	24- 0	25- 6	26-12	28- 3	30-14	31- 2	27- 1	2-12	24- 5-29-13

self and both anthropometer and table. All breadths are taken with a spreading metal caliper, and all circumferences with a tape, frequently checked against the anthropometer.

The number of cases upon which each distribution is based is given in the left-hand column of the tables.

Head Circumference: Circumference through supraorbital ridges anteriorly and greatest occipital prominence posteriorly.

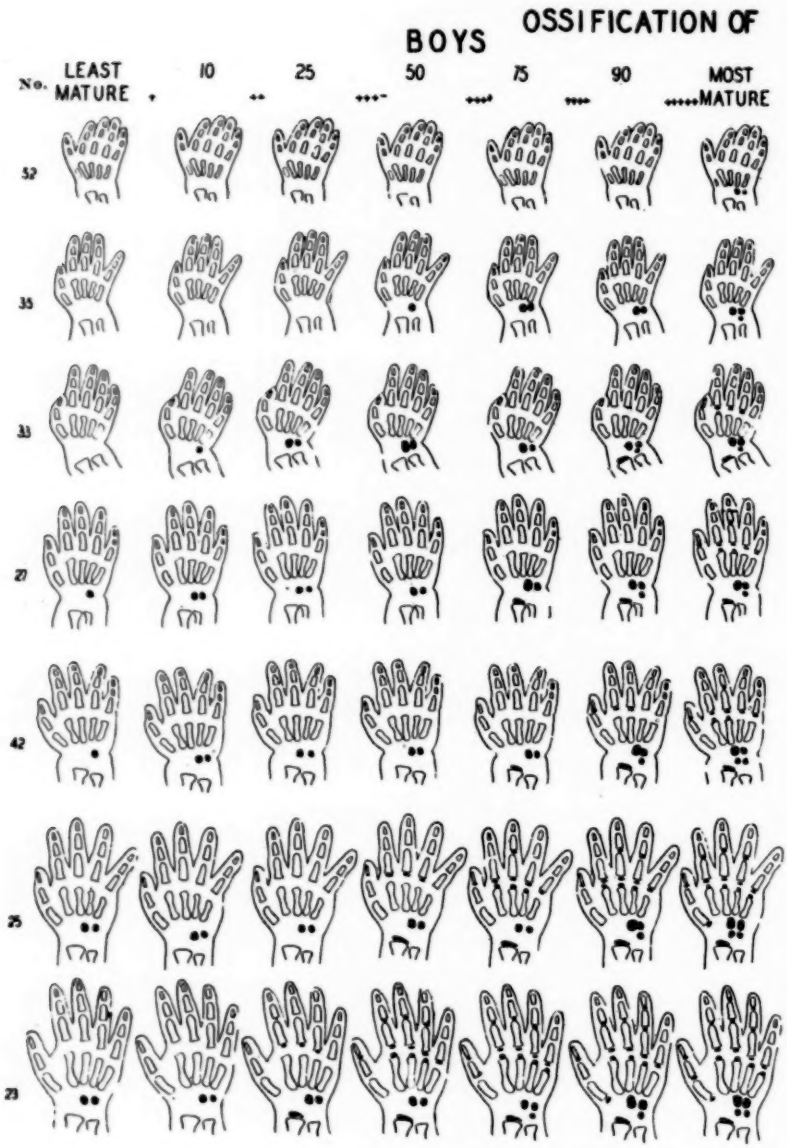
Chest Circumference: Circumference in plane of ensiform cartilage in midrespiration.

Interspinous: Transverse diameter of pelvis between anterosuperior spines of ilia. (The intercristal diameter, comparable to the bicristal of the International Agreement, is also being taken and is preferred, but the numbers are not yet adequate for setting up a distribution.)

Total Length: Recumbent vertex-sole length.

Weight: Taken in pounds and ounces and converted into grams.

Distribution of figures as given in Tables I and II are also available for the following: head breadth, head length, chest breadth, chest depth, abdomen, trunk length, and sitting length.


OSSIFICATION OF
BOYS
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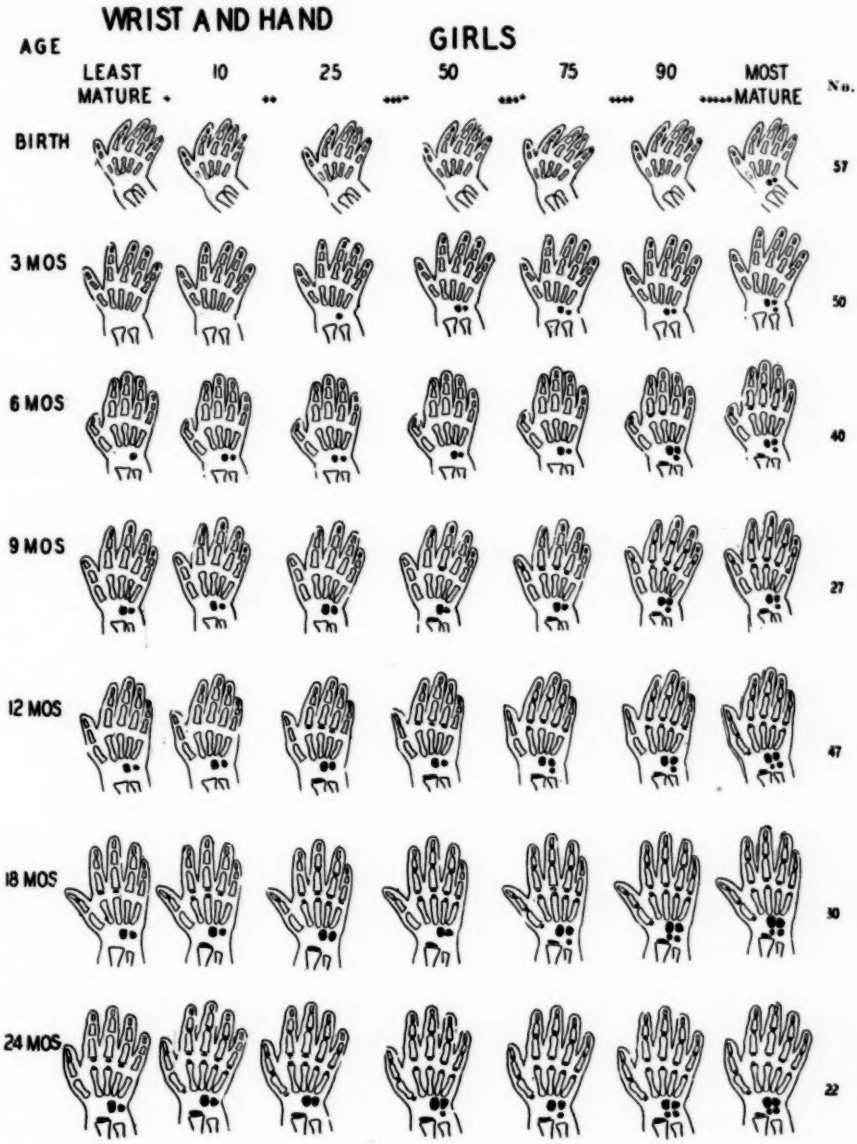
25
50
75
90
MOST MATURE
52
35
33
27
42
25
23

Fig. 4.


WRIST AND HAND
GIRLS
AGE
LEAST MATURE
10
25
50
75
90
MOST MATURE
No.
BIRTH
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12 MOS
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18 MOS
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24 MOS
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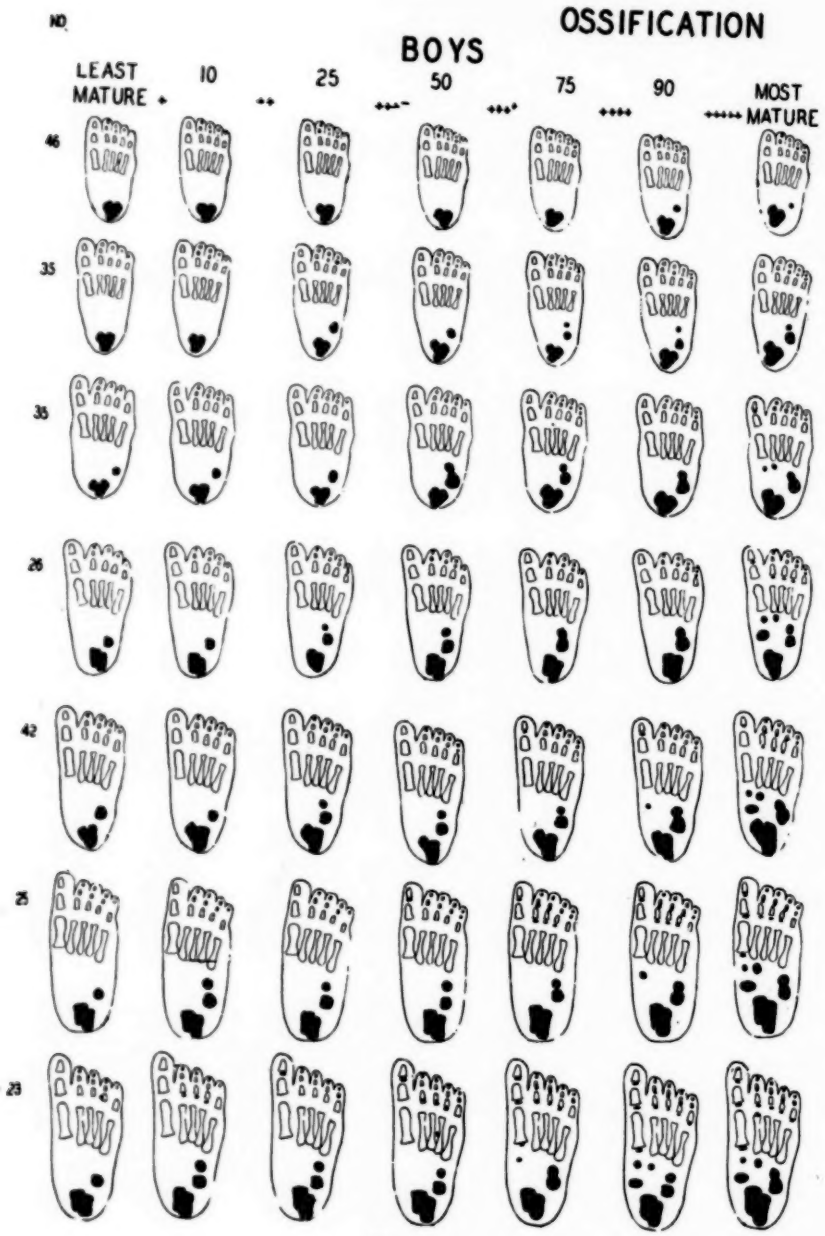
Fig. 4.


NO.
OSSIFICATION
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25
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MOST MATURE
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Fig. 5.

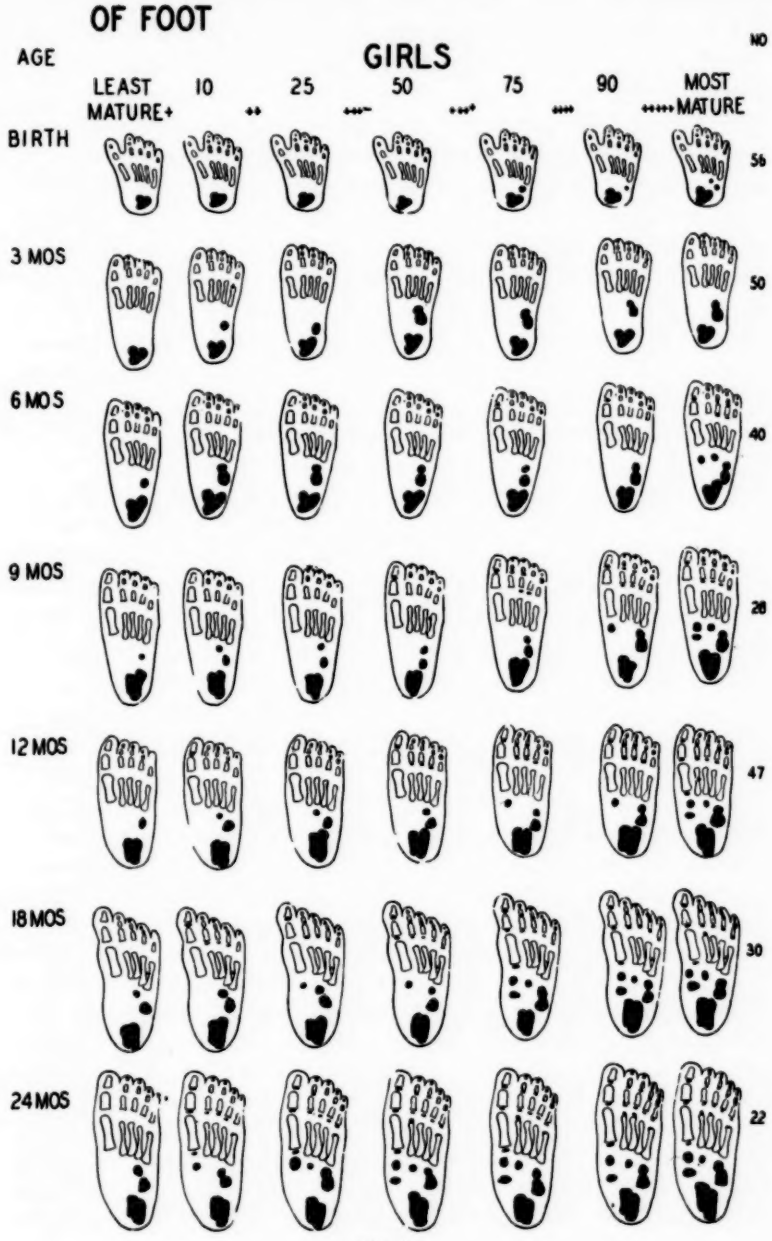
OF FOOT
GIRLS
AGE
NO
LEAST MATURE+
10
25
50
75
90
MOST MATURE
BIRTH
56
3 MOS
50
6 MOS
40
9 MOS
28
12 MOS
47
18 MOS
30
24 MOS
22

Fig. 5.

the question as to what measurements, if any, may be of practical value to the pediatrician in appraising the child. Our material is not as yet extensive enough to recommend any particular measurements. Our present feeling is that the number of measurements which can be taken with sufficient accuracy at this age to serve such a purpose is exceedingly small. The very attempt to secure and interpret a few simple measurements, however, seems to improve clinical judgment. It brings to our attention physical characteristics which would otherwise be missed and undoubtedly helps to cultivate and make more accurate the clinical powers of observation. Tables I and II give the percentile distributions, the limits of the ranges, and the means and sigmas of a few of the measures we have been using and have found helpful. We have similar distributions for other measurements as indicated in the footnote to the tables. The drawings in Figs. 4 and 5 show reproductions of hand and foot roentgenograms from our series, representing the percentile distributions of bone and epiphyseal development by sex and age. They indicate how epiphyseal maturation may be interpreted in much the same way as measurements. The appropriate drawing to represent the different percentiles has been chosen after arranging by inspection all x-rays in the order of advancing maturation. X-rays of individual children may be compared with these drawings and their relative position in respect to them determined by similar inspection. The numbers in most age periods in the tables and charts are still too small to be accepted as final, but there is no reason to believe that the distributions will be very greatly altered when they are revised with the addition of more cases.

Examples of curves plotted from the norms for the different percentiles of two measurements at successive age intervals are shown in Fig. 6. In considering progress, it is possible to plot any measure against such norms, just as we are accustomed to plotting weight against the average weight curve. However, a series of such charts becomes cumbersome. The technic can be greatly simplified if one makes a straight line out of each percentile. All that is lost in so doing is the visual picture of the changing extent of range at different periods. We have been recording in this way on a single chart all of the measurements of a child, making curves out of succeeding measurements, and have found that they bring into striking relief many interesting characteristics of individual children. This kind of record offers an excellent opportunity not only to recognize spurts and rests in general growth, but also to visualize changing proportions or localized arrests of growth. Examples of two such charts are shown in Figs. 7 and 8, but for simplicity only a few of the more important measurements are given. Fig. 7 shows a consistently small child, while Fig. 8 indicates both unusual

shifts in position from time to time and differences in position in different measurements at the same time. A record sheet which groups together the various evaluations of a child at a particular time is also

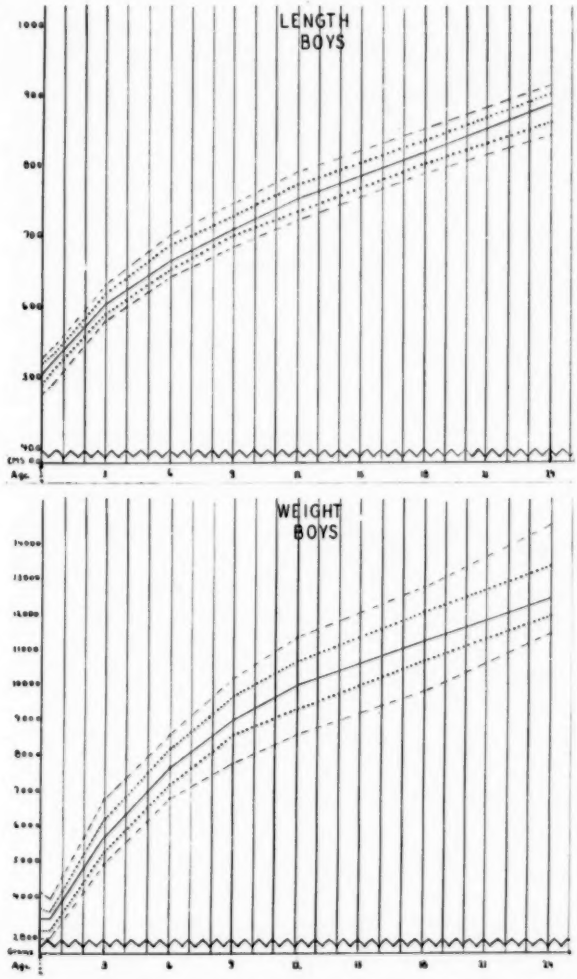

Fig. 6.—The measurements of length and weight given in Table I for boys plotted out as growth curves. By the use of such curves, measurements taken of children at intervening age periods not shown in the tables can be placed in the distribution and individual curves of growth can be plotted against these norms.

presented in Fig. 9 to show the way comparisons may be made between different kinds of data. The items under "other evaluations" in this chart are only suggestions as to what may be recorded in this way, and

fewer measurements may be used if desired. These charts are intended to suggest a method for using measurements in attempting to arrive at judgments regarding the physical fitness and progress of different chil-

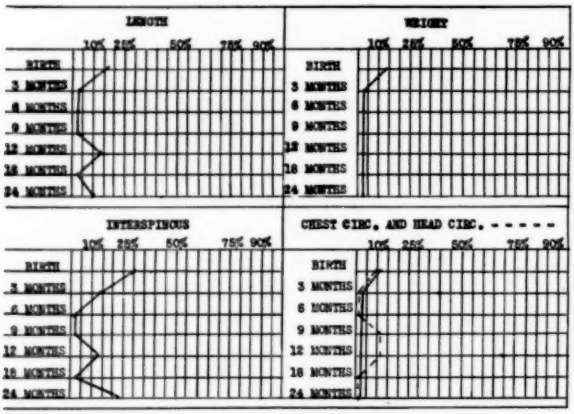

Fig. 7.—Individual percentile rank chart of measurements. These curves show a consistently small child throughout the period recorded. Her health has always seemed excellent and her musculature and nutrition have at each examination been considered perfectly satisfactory. (History No. 33.)

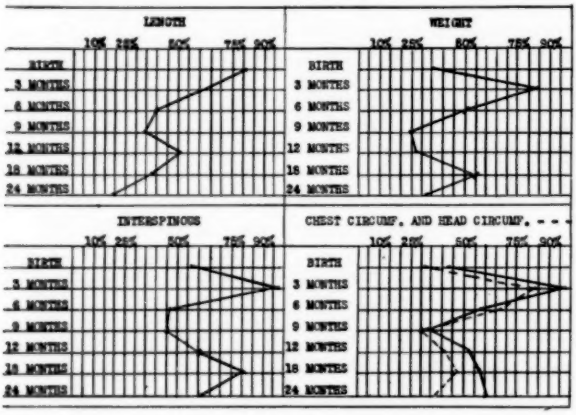

Fig. 8.—Individual percentile rank chart of measurements. This chart shows striking consistency in the position of different measurements at the same time, but very different positions at succeeding periods. These unusual shifts were obviously due to changing rates of growth. The early rapid growth was associated with successful breast feeding and good health. Following this, there was apparently compensatory acceleration of growth. The end-result shows a much shorter child than would have been predicted at birth, but in other respects her position was much the same. (History No. 6.)

dren, but are not urged for adoption in their present form, without modification to meet individual practice and needs.

The limitations to the practical usefulness of measurements are recognized, both because of technical inaccuracies and because of difficulties

in determining their significance. The number of measurements which can be taken with profit is small, particularly during the years covered by the accompanying tables. It is believed, however, that the very attempt to secure and interpret a few simple measurements improves clinical judgment and brings to one's attention physical characteristics

NAME: F. R. AGE: 12 MOS. HISTORY NO.: 131

MEASUREMENTS	ACTUAL	BELOW	RELATION TO AVAILABLE NORMS: UNDER 10	10 - 25	25 - 50	50 - 75	75 - 90	OVER 90	ABOVE
LENGTH	69.2		✓						
SITTING LENGTH	44.4		✓						
TRUNK LENGTH	27.8		✓						
WEIGHT	16-10		✓						
INTERSPINOUS	11.3		✓						
CHEST CIRCUMFERENCE	44.9			✓					
CHEST BREADTH	14.6			✓					
CHEST DEPTH	11.2		✓						
HEAD CIRCUMFERENCE	44.1			✓					
HEAD BREADTH	12.2		✓						
HEAD LENGTH	15.0				✓				

* OTHER EVALUATIONS	+	++	+++	++++	+++++
DEVELOPMENT OF WRIST AND HAND (X-RAY)			✓		
DEVELOPMENT OF ANKLE AND FOOT (X-RAY)			✓		
CLOSURE OF SUTURES AND FONTANELLES (INSP.)			✓		
DEVELOPMENT OF TEETH AND JAWS		✓			
DEVELOPMENT AND USE OF CHEST			✓		
AMOUNT OF SUBCUTANEOUS TISSUE (PALPATION)			✓		
QUALITY OF MUSCLES (PALP. AND USE) AND EXTREMITIES				✓	
DEVELOPMENT AND USE OF FEET			✓		
GENERAL RATING OF POSTURE				✓	
GENERAL RATING OF NUTRITION			✓		

DESCRIPTION OF BUILD: SMALL - WELL PROPORTIONED

PATHOLOGICAL FINDINGS: NONE

ESTIMATE OF HEALTH: GOOD

Fig. 9.—Individual developmental appraisal form. Single appraisal of an unusually small but well-proportioned and healthy one-year-old infant.

which would otherwise be overlooked. Their usefulness is, in large measure, dependent upon the way in which they are compared with standards and related to clinical data.

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55 SHATTUCK STREET

THE PEDIATRICIAN AND THE RURAL CHILD HEALTH PROGRAM

J. H. M. KNOX, JR., M.D.
BALTIMORE, MD.

SIR ARTHUR NEWSHOLME has stated, "The health and therefore the hygienic and medical care of every person in a community is a matter of concern and responsibility not only for himself but also to every other person in the community."

Preventable diseases occurring in a community should be regarded as a reflection upon each resident. This is especially true of unnecessary illness in infants and children dependent as they are upon adults for their health and well-being. In matters pertaining to health, the community naturally looks to its physicians for guidance and advice as it does to its business men in undertaking a financial project.

It is well known that the cost of illness and of preventive measures is out of reach, at present, of at least one-third of our population. To be ill, to these, is a luxury that cannot be afforded without going into debt. Outside of our large cities there is little provision for the medical, preventive, or curative service for those of limited means and many rural areas are quite without adequate medical services. Perhaps no one is more cognizant than the writer of the great amount of free, unselfish assistance that is rendered to the indigent by doctors, especially in the country and small-town districts. It must be recognized, however, that these services are often given in a haphazard manner as a favor and that with the best intention this laissez-faire method does not provide a community-wide plan to bring medical supervision within the reach of all. It is unfair to the physicians and unsatisfactory to the charity patients.

How ineffective our present methods are is indicated by the following data gathered almost at random. One-half of the women who succumb to some complication of childbearing have had no examination or prenatal advice before labor, and practically a third of the maternal deaths are due to sepsis. Notwithstanding the crowded living conditions in our large cities with their polyglot populations, their infant mortality rates in recent years have been lower than in surrounding rural areas.

Read at the Forty-Sixth Annual Meeting of the American Pediatric Society, Asheville, N. C., May 3 to 5, 1934.

A survey of rural infant deaths shows that about one-half of these little patients have never had a physician before the final illness. This means that in these cases the diet, care, and regime of the child have never been properly supervised. Again the White House Conference survey shows that but 1 per cent of rural children are protected against smallpox in their first year and but 3 per cent against diphtheria, and it is now recognized that protection from these diseases should be obtained before the age of six months. We are all familiar with the large proportion of young children who begin their long school career each year, more or less handicapped by some remediable physical disability.

In a large state university the physical examination of the students showed that those with the greatest number of bodily defects came from country homes; those from small towns and villages had fewer, and those from cities least of all. It is not to be implied that these and similar distressing facts are due solely to the negligence of doctors. Far from it. It is true, however, that the unsatisfactory conditions do exist principally among that part of our people who cannot afford to pay for medical services. This group consults the physician only in extreme illness or in an emergency. It is believed that this state of affairs will continue until a definite plan is put into practice in each community by which preventive and curative advice may be made available to every man, woman, and child who cannot provide it for himself. Even when this is done there will be many who, from ignorance or indifference, will not make use of the facilities offered. Many a careless husband will not take his wife to an established prenatal clinic. Indigent parents often neglect to avail themselves of free child health consultations. However, many more will seek this supervision when means of securing it are understood.

In a free country such as ours, a long period of health education is necessary before all our people appreciate the value of health and are willing to take the means recommended and provided to attain it. It is true, however, that until some method of obtaining medical examination and supervision is placed within the reach of all, much of the so-called educational health propaganda is ineffective and academic. To discourse to a household with little or no income on the importance of prenatal care, clean obstetrics, and periodic health examination for young children does not produce results unless a practical way of securing these recommended services is at hand. With how much more assurance can a nurse during a home visit advise the proper care of the expectant mother if the nurse has heard specific directions given at a prenatal clinic! How much more effectively can she supervise the diet of an infant if the child has been examined and the mother instructed at a child health consultation!

Every pediatrician is familiar with the objectives desired in a child health program. They can be summarized as follows:

A. For every mother
   1. Adequate prenatal care early in her pregnancy
   2. Satisfactory delivery service
   3. Postnatal examination and advice

B. For every child
   1. Periodic medical examination and supervision from infancy through childhood
   2. Provision for such curative and remediable treatment as may be necessary.

The inclusion of the care of the expectant mother in a child health program needs no explanation here. We all know that the present large neonatal mortality can be successfully combated only when the care of the unborn child is extended through the care of the future mother. This complete program resulting in children healthily born and reared is precisely that which all of you are providing for your own patients. Many will recall the paper presented at the last meeting by Dr. Aldrich in which he reported some 3,000 patients, many of them infants whom he had treated routinely, with only eleven deaths, and practically all from conditions that medical science has not learned to control. Such results are approximated in children who attend child health centers and hospital clinics regularly in the large cities. The problem is to be able to offer similar care to the children of parents of limited means in rural and village communities. John Dewey has said, "What the most intelligent parent desires for his children, that must the community desire for all its children."

The urgent need of developing additional child health services in the less populated areas in this country must be evident to all. It is, of course, among these scattered groups that the largest morbidity and mortality rates occur. The local physicians ought to lead in putting such community health programs into effect. In a number of instances, county medical societies have made agreements with county commissioners by which medical supervision is provided for the children of indigent parents. Such part of a physician's time as is devoted to a community child hygiene project should be paid for from public funds. County health officers cannot possibly perform the large volume of work required. Their number is far too small, and many other duties interfere. They can, however, cordially and enthusiastically support such a project inaugurated by the medical profession.

Probably concerted professional action to provide for the medical supervision of the lives of dependent rural children will lag until more emphasis is given to the subject of community health activities in

the medical schools of this country. When the embryo physicians are informed by their teachers that the most meticulous and skillful care of their private patients does not discharge the physician's whole duty to the community in which he resides, that the very knowledge and training he has received impose upon him the additional obligation to support in person or by his influence such approved methods as will promote the health of his neighborhood, when to his instruction in methods of investigation in diagnosis and treatment is added this sense of responsibility to the health of his community, a new generation of doctors will emerge who will furnish leadership to local health projects including the rights of dependent women and children.

In no field of medicine would this emphasis by the teachers of medical students be more productive of the desired results than in pediatrics. Signs are not lacking of the appreciation in many of our leading schools of the importance, of this added objective. In the meantime, no group of practitioners can be as helpful in ushering in this new day as the pediatricians. They knew at first hand the value of the pediatric supervision of the growing child. Unfortunately few men devoting themselves exclusively to the care of children reside away from our large centers. They are, however, members of state medical societies, often of county medical societies, and are frequently called into country districts to conduct pediatric clinics or in consultation. It is in this field that their reputation and their personal knowledge would be of commanding influence. If each pediatrician in the country were convinced that, notwithstanding his achievements in laboratory science or at the bedside, his duties to his neighborhood were not discharged until he did what he could in advocating the most practical plan of bringing preventive and curative pediatrics within the reach of every child in his community or state, a great impetus to the movement would be given.

The nature of the plan would naturally differ in various rural sections. In some it might be the establishment of a permanent child health center to which mothers of limited means could bring their children for advice. In other places, a system of itinerant conferences, returning at fixed dates to strategic points would accomplish like results, or again, certain physicians with the approval of their colleagues could set apart certain regular hours to receive similar patients in their offices. In all of these and similar methods, the services of public health nurses to assist in the examinations, to visit the families in their own homes, to help them carry out the doctors' orders, would seem indispensable. In some such manner every rural community could offer medical supervision to every child. Various plans of distributing the cost of medical attendance among large numbers of people through some form of health insurance seem to be gaining favor in this country. Many of these tend to stimulate prevention as well as the care of sickness.

Community projects, such as suggested, increase rather than diminish the doctor's private practice among his well-to-do patients. These soon learn to desire for themselves and are willing to pay for the evident advantages of periodic medical direction.

In a number of counties in Maryland the beginning of a plan for bringing medical supervision to all children is in successful operation. On receiving each birth certificate, the health officer gets into personal communication with the physician who signed it and asks him if in the case of the infant recently born, he, the physician, is willing to assume the responsibility of its supervision including the direction of its feeding and daily regime, its protection from smallpox and diphtheria and as far as possible from other infections, and if he will undertake these duties even *if he is not called by the family.* If the physician consents, as many do, he is considered a real "family doctor" and with that patient the health officer generally has no further concern. If, on the other hand, the physician replies that he is unwilling to see the child unless he is called upon by the family, the health officer inquires if he would object to having the public health nurse visit the family occasionally, note the condition of the child, and report to the physician in writing the result of each visit. This consent is rarely refused.

Again the physician may reply to the health officer that it is true he delivered the baby but only as an emergency or as a favor and that he does not think the family has any further claim upon his services. For this group of infants the health officer is at liberty to provide such supervision as he can through child health conferences, nursing home visits, or otherwise. In this way maximum use is made of the services of physicians. Those infants who will not receive the desirable medical supervision are listed, and some provision is made for their examination and care.

The plea is here made that the pediatrician who can speak with most experience exert his great influence in establishing in every rural district some plan for bringing medical supervision within the reach of every child in need of such assistance. Are we willing to admit that the unnecessary loss of infant life and the widespread incidence of remediable defects is a part of the price that must be paid in a democracy for that vaunted rugged "individualism" even among physicians pledged to do all they can to alleviate human suffering? Must the "law of the jungle" apply to the defenseless infant and young child, or has the community a responsibility for the care of those for whom their parents cannot properly provide?

Rumbles of the news of the widespread provision for the protection and fostering of child life in Soviet Russia, resulting in a 50 per cent reduction in infant mortality rate in recent years, are becoming more and more audible in this country. There the protection of motherhood

and childhood is recognized as one of the most important functions of the state. Does it require a system of communism or of autocracy to extend the benefits of medical science to every child? Surely we must believe that through the wider application of the knowledge already at hand and with the cooperative leadership of the medical profession in this country, such skilled guidance may be extended to all our children and particularly to those in our far-flung rural areas, and that here in democratic America, preventable disease and death in the rising generations shall eventually be done away. In ushering this new era, no group among physicians can play so important a rôle as the pediatricians, whether their major interest is in research or in bedside practice.

Critical Review

PROBLEMS OF THE NEWBORN

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THE ANTENATAL PROBLEM

INCREASING interest of nonmedical groups in maternal and neonatal problems has led to an energetic but not especially well-organized campaign to improve antenatal conditions. Owing to the enthusiasm and perhaps hysteria that so often attends any new lay public health project a goodly amount of misinformation has been bandied about, and there has been a gradual but consistent tendency to encroach upon purely medical phases of the subject. Faulty statistical deductions have led to gross exaggeration of existing conditions and to the propagation of erroneous or unsound ideas. Hurried adoption of antenatal programs in many instances has resulted in waste of considerable time and energy upon obsolete or traditional practices of a more or less trivial or even harmful nature. To a large degree the very rapidity with which a drive of this sort gains popularity in the end serves to endanger its objective and hamper its efficiency by expanding at such a rate that it is impossible to supply an adequately trained personnel with the critical and conservative attitude necessary to direct a new movement. The result is that many of the sound basic principles evolved painstakingly by pioneers in the field are lost sight of in the avalanche of educational ballyhoo hurriedly developed by the hordes of enthusiasts who rush to join any new social movement. This in turn permits alert but unscrupulous commercial concerns to utilize this pseudoauthoritative information in their quasi-medical advertisements.

Primarily the problem of improving antenatal conditions is a medical one by virtue of the inescapable fact that the doctor will be required to carry out most of the work. It depends upon medical methods of approach and management if it is to succeed. Therefore, it seems not only advisable but imperative that the lay groups which have shown so much interest and enthusiasm in this project should acknowledge their scientific limitations and adopt a program based upon conservative medical leadership. If welfare organizations are to adhere to the unselfish and humanitarian principles upon which they are conceived they must subjugate themselves in this way rather than to antagonize the medical profession by presuming to engage in medical practices far beyond their capabilities. Then the dangers and errors to which such movements are subject may be prevented at the very outset and the objective reached without the development of a

complex, unwieldy, and costly type of organization which has hampered other movements of this kind.

Many of the difficulties of a campaign of this nature could be obviated if medical and nonmedical agencies would become conversant with each other's problems, attitudes, and methods of approach so that a comprehensive but practical and well-correlated program devoid of duplication of effort and radicalism could be developed. A dispassionate critical survey of the entire subject would lead to correction of existing defects of the several groups and to an equable solution of any controversial questions. This viewpoint would be productive of greater success than maintenance of the present attitude of some that theirs is the only group not at fault. Certainly the outstanding fact that so far the total maternal and neonatal death rates have been unaffected by the more or less independent efforts of these agencies indicates the need for closer cooperation between them.

MORTALITY AND MORBIDITY

Although an abundance of statistical information relating to maternal and neonatal mortality is at hand, it is exceedingly difficult and at times impossible to make interpretations or comparisons and still avoid the rather common mistake of basing unwarranted criticisms on wrong conclusions. For this reason rigid comparisons of rates between two countries or areas and sweeping generalizations based upon small groups must be carefully and impartially checked to prevent dissemination of erroneous information as, for example, superficial comparison of United States maternal mortality rates with those of other countries or generalizations on the preventability of neonatal mortality.[1, 2, 3, 4] These difficulties are due largely to differences in method of computing and interpreting rates, diversity of racial characteristics of the population, and finally variations in definitions. For instance, the definition of stillbirth is not identical everywhere. This has led the United States Bureau of the Census to warn, "There is no single definition of stillbirths in general use among the states nor is the term 'stillbirth' used in the same sense in the various states. Therefore, interpretation of the statistics should be made with extreme caution as their registration is based upon a different basis."[5] Nevertheless, after perusing some of the innumerable reports at hand it seems safe to make a few general observations.

1. Maternal and neonatal mortality rates quite generally are held to be too high in the United States.

YEAR	PER 1,000 POPULATION		INFANT DEATH RATE*	TOTAL MATERNAL DEATH RATE PER 100 LIVE BIRTHS
	BIRTH RATE	GENERAL DEATH RATE		
1921	24.2	11.6	75.6	6.8
1926	20.7	12.3	73.3	6.6
1931	18.0	11.7	61.6	6.6

*Neonatal deaths included with infant deaths.

2. If the neonatal rate is considered separately from the infant death rate under one year, no material change will be found in either for the past 20 or even 50 years,[6, 7] in spite of definite improvement of

medical conditions. Thus, while great advances in medical knowledge have caused a marked reduction in the general and infant death rates over years, the maternal and neonatal rates are unchanged. Increased interest in antenatal care has not affected so far the total maternal and neonatal rates.[8] This seems to imply that the campaign has not reached the majority of the population or that proper antenatal measures have not been used. So-called improved obstetric care has not affected these rates, thereby leading to the conclusion that either measures are not actual improvements or that their apparent good is obscured by other factors. This situation is all the more significant for it would seem that general improvement of nutrition and health over years should exert a favorable influence upon health during pregnancy. Furthermore, while no authentic statistics are available, it is probable that the child welfare movement of the past thirty years should have had a salutary effect upon parturition by reducing the incidence of rachitic pelves with consequent reduction of difficult labors.

3. There has been no appreciable reduction in the incidence of stillbirths in spite of generally improved health conditions. For instance the rate per 100 live births was 3.8 in 1931 and 1932, figures that have varied but little since the collection of stillbirth records was begun in 1922.

4. Prematurity still continues to be a potent factor in the high neonatal death rate and its incidence has not been materially decreased.[9] Spontaneous abortion and prematurity account for the termination of at least one out of six pregnancies.[10]

5. A great number of maternal deaths, stillbirths, premature births, and neonatal deaths are preventable, but the percentage is not as high as ordinarily given. Thus while two-thirds of the maternal deaths are considered theoretically preventable one-fourth are due to abortion, spontaneous or otherwise, at least one-half of which probably could not be prevented. Responsibility for one-third of the avoidable deaths apparently lies with the patient, and for 60 per cent with incapacity of the attendants. This indicates the need for education of both the patient and the attendant.[11] Many fetal deaths are due to causes beyond control of the obstetrician at the time of delivery. Including viable premature births, about 30 per cent of stillbirths and neonatal deaths are thought to be avoidable.[12] The view of some that from 30 to 50 per cent of prematurity is preventable stresses the importance of proper antenatal care.[13]

6. The high incidence of operative interference has an important relation to maternal mortality. In the New York City study more than 45 per cent of the maternal deaths, exclusive of abortion and ectopic gestation, followed operative deliveries. Naturally many of these were unavoidable deaths but in a larger number of them the necessity for operation could be decreased considerably by improved antenatal care and education of doctors and patients.

7. The stubbornness with which maternal and neonatal death rates resist the effects of improved medical knowledge shows that there is a very close association between the two. Hence, with reduction of maternal rates one should expect neonatal rates to be lowered.

FACTORS INFLUENCING THE ANTENATAL PROBLEM

The task of reducing neonatal morbidity and mortality rates through improvement of prenatal care is a complicated one because it involves to a considerable extent several branches of medicine: obstetrics, pediatrics, internal medicine, and dietetics. The pediatrist who probably up to the present time has displayed most interest in the neonatal phase of the problem is limited in his ability to better conditions because he has little opportunity to influence antenatal factors directly. He must perforce attempt to cure neonatal disorders which in many instances could have been prevented by proper antenatal measures or obstetric methods. Indirectly his efforts along educational lines, which include censure of existing laxity in the care of the pregnant women, lay him open to the just criticism that his knowledge of obstetric problems is too meager or impractical to warrant such tactics. Another complication is that the general practitioner does and still will continue to care for most maternity patients. This means that the brunt of any drive to reduce mortality and morbidity must be borne by him. While organization of the American Board of Obstetrics undoubtedly will promote the practice of better obstetrics, temporarily at least it will result in increasing the number of deliveries by the general practitioner since there will be fewer posing as obstetricians. It is, therefore, all the more imperative that every possible effort be made to enlist the cooperation of those doing general work. Impartial analysis of the problem necessitates criticism of all of the groups interested in improvement of antenatal conditions:

1. *The General Practitioner.*—Most members of this group are more anxious to cooperate than ordinarily supposed, provided that it is practically possible for them to do so, because their relationship with the family is more intimate and their interest more personal than that of many specialists. However, it must be remembered that general practice is far different from specialized institutional practice. Therefore, if a sensible and practical plan for improvement of the antenatal situation is to be formulated, it will be necessary for those who devise it to cast aside some of the academic idealism so common among those associated with teaching institutions. With all the furor of criticism of the general practitioner one cannot help but feel that many of his fallibilities are really those of his teachers who, secure in their well-equipped hospitals, make no attempt to understand the conditions into which he will go after completion of his training. One wonders if they could do as well under the circumstances, especially if they were to indulge in some of the practices they advocate so strongly. If reports on rural obstetrics like the one of Peck's could be brought to their attention, perhaps their critical ardor would be dampened considerably.[14] Since most of the deliveries still occur in homes or hospitals not ideally equipped, the present trend toward complexity of armamentarium and technic should give way to one of simplicity. The same may be said for antenatal care. If the conscientious family doctor is shown the value of proper antenatal care and is provided with a workable plan for carrying it out, his cooperation in the drive to reduce maternal and neonatal mortality can be assured. However, a certain number of doctors will remain disinterested. These are the ones who admit their dislike for the practice of obstetrics but perniciously and dishonestly refuse to abandon it because it serves as a feeder

for the rest of their practice. Another factor which is responsible for the lack of interest in the subject is the wholly inadequate remuneration received for an obstetric case.

2. *Teachers and Teaching Institutions.*—It is generally conceded that the curriculums of medical schools are deficient in respect to the study of the newborn and the preventive aspect of obstetrics. More attention has been paid to pathology and treatment of obstetric complications than to their prevention by proper antenatal care and as a whole teachers have failed to emphasize to the student that the training he receives does not qualify him to practice operative obstetrics. The assumption that the pregnant woman should be permitted to continue her way without medical supervision until labor has set in is no more tenable or baneful than the unjustifiable attitude of some that pregnancy is always pathologic. While convinced of the necessity for continued medical supervision and guidance during pregnancy and labor, provided it is sane and conservative, sanction cannot be given the sort of meddling that has become the increasing vogue in the last few years. A goodly amount of this may be attributed to those obstetricians who orthodoxically teach undergraduates obstetric principles, only to ignore them in their own practice, and, what is even more pernicious, advocate general adoption of certain procedures which in the hands of the less skilled at least cannot help but affect maternal and neonatal mortality deleteriously. Paradoxically they teach that vaginal trespass is the common cause of puerperal sepsis and then blithely extol the virtues of routine versions, or prophylactic (?) forceps[15] and cesarean section on slight indications.[16] Such practices are responsible for the unnecessarily high incidence of operative deliveries and the consequently high mortality rates.[11] Greater emphasis should be laid upon the sanctity of the birth canal than upon measures not devoid of danger to both mother and infant since even the most irrational cannot deny that the incidence of puerperal infection is directly proportionate to the frequency of operative interference. Certainly a more conservative attitude would have prevented a recent incongruity—a popular proponent of one of these routine operative measures lamenting the well-known fact that mortality rates are higher in hospitals than in homes. The excuse that some of these operations are for the protection of the infant may be true to some extent, but so far they have produced no favorable effect upon the neonatal mortality. In view of the fact that there should be a natural reduction owing to improved nutritional conditions and decreased incidence of rachitic pelves, it is entirely possible that wide adoption of some of these operative procedures has really increased the incidence of maternal and fetal deaths. It might be advisable for American schools to adopt a policy similar to that mentioned by Adler: "The Viennese school has always been very conservative about obstetrics. We try to avoid too great radicalism, and, therefore, our results are better than those elsewhere. We are trying to teach our students more what nature can do, and by doing this I think we have been able to show good results."[17]

What has been said about manipulative measures may be reiterated for the routine use of some of the pain-saving procedures. They may be of merit in the hands of those who are able to choose their cases

and keep their patients under continual observation during labor, but this is not true of the country in general where it is not always possible to give the patient such ideal care. Furthermore, until there has been a more thorough analysis of the effects of some of these forms of analgesia upon the fetus and newborn infant, one cannot accept all of the reports with full credence.

3. *The Laity.*—For years the public could be criticized for its indifferent attitude toward the pregnant woman, but in the last few years greater interest has been manifest. Whenever the public becomes convinced of the need for some sort of medical attention it welcomes enthusiastically but uncritically any or all information on the subject regardless of its actual or reputed worth. This happened when it became conscious of its deficiencies in respect to infant welfare, and it is happening now with regard to pregnancy and labor. Popular interest in paturition has led to a luxurious growth of lay literature of such variable value and authenticity that it is difficult often for even medical men to sort out what is worth while. A dietary vogue of such complexity has developed that many physicians actually have concluded that diet of the pregnant woman is beyond their comprehension and that they must direct her to a dietitian for proper instruction. Similarly through the pernicious dissemination to the laity of information regarding short and painless childbirth, the physician has been forced to adopt, perhaps without the development of a proper degree of skill, measures which even in the best of hands may increase the hazards of life and health to both mother and child. Such publications as *Easier Motherhood*[18] have done infinite harm by the insidiousness with which there has been created a lay demand for comfortable labor when the methods advocated have as yet not entirely satisfied the fetal and maternal requirements regarded as essential by sincere, cautious, and critical authorities. Perhaps lay authors should not be criticized as much as the physicians they blindly quote without realizing that some of the measures recommended cannot be carried out safely in all parts of the country at present. Nor should the medical profession be absolved from all the blame for its weakness in refusing to adopt unproved methods or to yield to the whims of those unqualified to judge. Unwittingly or not, encroachment upon purely medical features of antenatal care has resulted in definite lay domination of the doctor, a practice which must be discouraged. Deploring an operative trend among physicians to meet the demand of women for short and comfortable labor, Ehrenfest[19] states that this could be curbed best by advising them that such measures are not devoid of certain risks to themselves and their infants. Remarks of this sort should help to counteract some of the fallacious opinions the public has of these procedures, for were mothers to be told the unbiased truth, they would not submit to some of them. Certainly before new methods are recommended for general use or, above all, advertised to the laity, they should be referred to members of the obstetric profession capable of making a critical and impartial analysis of their safety and value. Until then one cannot hope for much change in mortality rates as far as labor is concerned.

Lay workers must come in for their share of criticism. Because the medical profession has been remiss in its interest in antenatal prob-

lems a great deal of this work has been taken over by lay organizations. They have been successful in educating the public about the need for prenatal care but, unfortunately, as is so often the case some of the more essential points are lost sight of in the enthusiasm for less consequential measures that are easy to carry out. For instance, more time is spent upon many of the trivial matters of hygiene which can have but little effect in actually lowering mortality rates than upon seeing that these women receive the particular and special medical care necessary to prevent prematurity, stillbirths, and neonatal or maternal deaths. After all, there is much more to antenatal care than filling out long record blanks, telling the mother what clothes both she and the baby need, how much exercise she should take, how the breasts or even the skin of the abdomen should be cared for, or taking blood pressure, urines, and blood for Wassermann examinations. Furthermore, entirely too much attention has been devoted to development of a superorganization comprised of nurses and professional or voluntary social workers and evolution of a complicated costly and time-consuming program which cannot be carried out successfully in many parts of the country. The need is for a simple plan that can be adopted by small organizations and by general practitioners so that private patients may secure as good prenatal care as the clinic patient. Those who devise such a workable program should bear in mind that it need not be as intricate as one prepared for a research institution. It should not be so tediously comprehensive that it will not be adopted by the busy physician who has neither the time nor help to carry it out.

SOME MEDICAL ASPECTS OF ANTENATAL CARE

So far antenatal care has consisted chiefly of attempting to prevent the occurrence of complications of pregnancy which may have an unfavorable effect upon the mother at birth. The fetus obviously has benefited from this indirectly, but primarily the attention of the obstetrician has been focused on the actual mechanical process of childbirth and on the treatment of illness associated with pregnancy rather than upon the relation of good health and nutrition to the normal functioning of the various organs. Prenatal care is a greater task than may be apparent at a cursory glance for it involves not only the cure but the prevention of disease by the inadequate means at our disposal at the present time. It begins very early in the life of the potential mother for as Mellanby[8] has said, "The soil is often as important as the seed." Affections which may seriously influence pregnancy directly or indirectly by their sequelae frequently appear in the fetus, the infant, or the child long before the reproductive system becomes mature. This is especially true of rickets, syphilis, tuberculosis, or cardiorenal disease. Even fertility must be considered in this problem. Nevertheless, however complicated and extensive the subject, it can and must be reduced to as simple an approach as possible. It is not the purpose of this review to deal as much with purely obstetric problems which may prevent neonatal mortality and morbidity as to consider factors which play an important part in the development of a normal full-term infant, in the continuation of this normality throughout labor and the neonatal period, and in the prevention of premature births and stillbirths.

I. *Nutrition*

At present we are passing through a period in which most of the laity is diet conscious. Owing to absurd advertisements by radio and press and to the fanaticism of some dietitians who seem unable to think in other terms than nutrition, many doctors have become wearied with the endless chatter about diet and in some instances so thoroughly disgusted that they are wont to disparage some of the really conservative views about the subject. After admitting the necessity of the various food factors in pregnancy, if the child is to start life with a well-developed body and vigorous constitution, Still amusingly remarks, "After reading some of the present-day writings on the subject one can hardly believe that there were babies, and even healthy babies borne in early Victorian times, when people were so benighted that expectant mothers lived on their ordinary diet, without the addition of any special vitamin preparation or even weekly doses of ultraviolet rays."[20] As certain as we are of the need of proper foodstuffs there is yet no reason for the physician to feel that supervision of the diet of the pregnant woman is beyond his intelligence. Nevertheless, the diet is believed to be a more important factor in pregnancy than formerly was thought to be the case.

General Nutrition of the Fetus.—It is fairly well established now that an unbalanced diet will not furnish the embryo the best medium for development. The chemical substances essential for the development of normal fetal tissues may not be present always in sufficient amounts in the maternal tissues, and, since some of them cannot be synthesized by either mother or child, both may suffer unless they are supplied in the food. Apparently more demands are made upon the maternal tissues by early rather than late fetal growth. Whether the early tissue sacrifice can be prevented by providing a more complete dietary at this time is not definitely known although it seems conceivable.[8] Dietary imbalance favors the birth of premature or congenitally inferior infants who are more susceptible to disease or of apparently normal infants who later manifest susceptibility to rickets and infection. Recently the exceptionally well-controlled studies of Toverud[21] have shown that there are many exogenous factors affecting the nutritional condition of the newborn which can be prevented by proper prenatal care. Her observations confirm the findings of Abels[22] and others that there is a seasonal variation in weight and length at birth and indicate that the greater size of babies born in the summer months is probably due to the abundance of fresh fruits and vegetables in the maternal diet and to the increased vitamin content of the milk during this season. Bivings'[24] findings are similar but he also finds that there is a sharp rise during the fall quarter in the incidence of hernia, prematurity, and deaths during the first week of life which he attributes to a deficiency of ultraviolet radiation or vitamin content of the food at this time of the year. Social conditions such as hard work in the latter months of gestation and illegitimate pregnancies are known to increase the incidence of prematurity and babies of low birth weight. By systematic prenatal care Toverud was able to increase birth weights and reduce the number of premature births. In turn there was a reduction of the neonatal mortality rate. Her studies also seem to indicate that the fetus is not entirely parasitic.

Minerals.—There is evidence that points to the importance of an adequate calcium content of the maternal diet if postnatal rickets, tetany, and even congenital rickets are to be prevented.[25] If the maternal intake of calcium is less than 0.7 gm., the average for nonpregnant adults, and the offspring needs 25 gm. in the last twelve weeks of intrauterine life and even more in the nursing period, obviously maternal depletion of this mineral will occur.[8] Toverud's studies[26] show that there is a negative balance of calcium and phosphorus in pregnancy which can be corrected by increasing the daily intake to 1.6 gm. of calcium and 1.8 gm. of phosphorus and in some instances by increasing the vitamin D content of the food through feeding cod liver oil or egg yolk. These investigations and many others[27, 28] may help to explain the relationship of alterations in the calcium and phosphorus metabolism to osteomalacia and tetany in pregnancy and possibly the early and late toxemias of pregnancy.[29, 30, 31] The old saying, "For every child, a tooth," seemingly is becoming more acceptable in view of indications that a faulty calcium and phosphorus consumption combined with a low vitamin D intake may be largely responsible for dental caries.[32, 33] Since calcification of milk teeth is well advanced in utero it seems essential for the production of good teeth to supply the pregnant and lactating woman with plenty of these elements. The earlier the mechanism of perfect calcification is begun, the more easily will the infant be able to withstand the handicaps of poor postnatal feeding. The maternal calcium reserve is dependent not only upon an adequate consumption of calcium-containing foods but upon the presence of a sufficient amount of the calcium-mobilizing factor, vitamin D. A quart of milk contains the required amount of calcium and phosphorus in easily assimilable form. When milk consumption is low it may be supplemented with cheese, the leafy vegetables, especially lettuce, or by the ingestion of calcium lactate or dicalcium phosphate which seem to be as efficiently utilized as raw milk.[34] While there is considerable clinical and laboratory evidence that depletion of calcium may be responsible for many of the disorders of the pregnant woman and fetus, so far the proof is not unimpeachable.[35] It seems safe to assume, however, that the average American dietary is deficient in calcium. Sherman believes that there is probably a greater deficiency of this element in the ordinary diet of adults and children than of any of the others.[36] The absorption of calcium is hindered by excess of fats, cereals, and phosphorus, while an alkaline intestinal reaction, the oxalic acid of leafy vegetables, and the addition of lactose or cod liver oil favor the absorption of both calcium and phosphorus.[37]

Fetal demands for iron in the last trimester of pregnancy is responsible for a considerable drain of iron from the maternal store. The effects of this are seen in the frequency of other than the so-called physiologic anemia in pregnant women. The fetal hemoglobin content at birth is not affected appreciably by maternal anemia,[38] but it is possible that maternal nutrition is responsible for an inadequate fetal iron reserve and for the subsequent development of nutritional anemia during the nursing period, a time when the intake of iron is especially low.[39] Obviously manifestations of anemia are common in prematurity. Since anemic infants are particularly prone to infection

it seems advisable to supply an adequate amount of the hemopoietic principles in the maternal diet in hopes that fetal morbidity and mortality may be reduced. Reports of the inhibition of lactation from deficiency of manganese in animals serve to show how complicated a problem childbearing may be.[40]

Iodine-poor diets, common in goitrous regions, favor the development of maternal and congenital goiter. In regions where cretinism is endemic it is reported to be absent in the offspring of women receiving during the last five months of pregnancy the equivalent of 0.1 gm. of iodine in the form of iodized salt.[41] So far there is no evidence that sporadic cretinism is due to iodine deficiency. Other good sources of iodine are sea foods, cod liver oil, and pills of organic iodine.

The Vitamins.—Discrepancies in the reports of various investigators have led to a great deal of confusion in regard to the relationship of vitamin deficiency to disease in man. There are several reasons for this. Deficiency diets do not act uniformly in different laboratory animals and in man. Therefore, translation of laboratory data in terms of the human is not always to be relied upon particularly, so that experimentation in man is exceedingly difficult to control or interpret and in many instances it is unfeasible. Clinical observations on the effect of milk-vitamin deficiences in man are subject to criticism owing to the fact that there are few reliable methods for detecting mild forms of vitamin insufficiency. Furthermore, since it is doubtful if avitaminosis ever occurs uncomplicated in man, accurate evaluation of the effects of deficiency of any one is difficult.[42] Such factors serve to complicate the issue by permitting biased enthusiasts to arrive at unwarranted conclusions about the functions of different vitamins. These are used with avidity by commercial houses to advertise the value of their various products. In spite of this situation there is no need for the doctor to consider the subject of the vitamins too complex for his consideration for after all there are only a few definite facts known about them that concern him. During periods when unusual demands are made upon the body such as pregnancy and lactation, there is more likely to be deficiency of some of the vitamins.

It is ordinarily assumed that vitamin A or its precursor carotene does not seem to be lacking in the average diet of pregnant American women provided certain dietary vagaries are not practiced. There have been few investigations regarding the vitamin A requirements during pregnancy. An added intake would seem advisable to supply the fetal needs but this should not be excessive, for there seems to be some factor at work limiting strictly the amount of the vitamin passing through the placental barrier.[43] Thus the newborn store cannot be enriched to any appreciable extent by excessive fortification of the maternal diet with vitamin A. The recent work of Jeans and Zentmire[44] who devised a method, which they consider reliable for detecting mild forms of deficiency of this food factor in children, points to the possibility that perhaps vitamin A avitaminosis may be more common in man than formerly supposed. Further confirmation of these studies is necessary before the question can be settled. Vitamin A is thought to maintain health, vigor, and growth by preserving the physiologic integrity of the various epithelial structures so that the defense

mechanism against bacterial invasion is maintained.[45] Yet it does not appear that vitamin A can be called the "anti-infective vitamin," by virtue of any direct bactericidal or immunologic power. Such a function would theoretically agree with the observations of Green[47] and Mellanby[46] that vitamin A may be used successfully for the prophylactic treatment of puerperal sepsis. Until this can be corroborated in a larger series of cases, the question should be left open. In view of the fact that this accessory is considered essential for the maintenance of health and resistance to infection the pregnant woman's diet should contain an ample amount of green vegetables and dairy products. In questionable cases cod liver oil or other fish liver oils may be given.

The situation in respect to vitamin B has been complicated recently by developments which have led to the assumption that what was formerly believed to be the single vitamin B is probably a combination of seven or more factors. Temporarily the vitamin B complex is considered made up of two factors, vitamin B (F or B_1) and vitamin G (B_2). Unfortunately many of the reports about their various actions are subject to criticism.[48] Owing to a number of articles indicating the possible relationship of polyneuritis of pregnancy to deficiency of vitamin B, the antineuritic factor, it is possible that more attention should be paid to this food accessory in the diet of the pregnant woman.[49, 50, 51] Especially does this seem to be true in cases of pernicious vomiting of pregnancy where there may be lack of vitamin B as well as of others.[52, 53] In animals, and possibly in man, there are indications that deficiency of the vitamin B complex may retard lactation.[54, 55] Of the two, vitamin B seems more likely to be the important factor than vitamin G. Pathologic findings similar to beriberi have been reported in newborn who have died from hemorrhagic disease.[56] Experimental studies confirm the clinical observation that deficiency of vitamin B in the maternal diet may be responsible for manifestations simulating infantile beriberi.[57]

The intimate relations between vitamin D and the metabolism of calcium and phosphorus have resulted in detailed study of this subject in pregnancy and infancy, periods when there is an increased demand for both of these minerals. Vitamin D influences the absorption of and retention of calcium and phosphorus, their concentration in the blood, and their deposition in the skeleton. It is rather generally conceded that a deficiency of this vitamin during pregnancy and lactation predisposes to the development of rickets, abnormal dentition, and possibly tooth caries, not only in the offspring but in the mother.[25] During pregnancy there is particular need for calcium and phosphorus which are mobilized by vitamin D because of the growing demand for them upon the part of the fetus. Since the maternal storage of these minerals is variable at this time and usually insufficient, they must be obtained from the maternal tissues, especially the bones and teeth, or the fetus will not receive the proper supply. The rather general diminution of serum calcium during pregnancy[58] is thought by some[59] to be an etiologic factor in maternal toxemias, tetany, and eclampsia. Similarly such deficiencies are probably responsible for the occasional reports of congenital rickets[60, 61] and tetany in the newborn.[62, 63, 64, 65] Frequent recognition of the latter in late years has led to a controversy regarding whether or not the

condition is due to a primary low serum calcium or a secondary decrease from the loss of plasma chlorides from vomiting. It is probable that either may be the cause. No matter what the cause or whether Shannon's idea[66] that many cases of tetany are being mistaken for intracranial hemorrhage is true or not, the presence of rickets or of tetany, especially when there is a low serum calcium, indicates that more attention should be paid to the maternal supply of calcium and vitamin D during the antenatal period. The long recognized association of calcium with blood clotting function has led to study of the effects of vitamin D on this phenomenon. There is some evidence that the administration of vitamin D will augment the absorption of calcium so that the capillary permeability of the blood vessels will be decreased and bleeding and clotting times increased.[67, 68] In view of a rather generally conceded calcium and vitamin D deficiency in the average dietary of pregnant women, proper antenatal care should include investigation of the diet in respect to possible deficiencies of these food factors. It must be remembered, however, that vitamin D is merely a mobilizer of calcium, not a substitute for it. Diets deficient in vitamin D should be augmented by the addition of cod liver oil, viosterol, or possibly some of the irradiated foods. Ultraviolet irradiation of the body will give similar results provided it is not used too zealously.

Vitamin C is rarely deficient in the diet of the pregnant woman for fresh vegetables and fruits are usually easy to obtain and owing to newer methods of preparation canned vegetables and fruits contain an increased amount of this vitamin today.[69] An abundance of this vitamin seems necessary for it is thought to play a decided part in the prevention of dental caries.[70] There also seems to be an interrelationship between vitamin C avitaminosis and bacterial infection.[71]

While in rats deficiency of vitamin E produces death and resorption of the embryo, there is little authentic information regarding the need of humans for this vitamin.[72] The unconfirmed investigations of Vogt-Møller[73] indicate that habitual abortion may be successfully treated by ingestion of vitamin E during pregnancy.

Fats, Carbohydrates, and Proteins.—Greater variation of these foodstuffs in the dietary of the pregnant woman seems to be permissible without seeming to affect the maternal health and fetal development, but even so the influence of certain deficiencies may be observed clearly. While the tendency upon the part of some to emphasize that overfeeding is more dangerous than underfeeding may have led to a fad for dietary restriction with resulting inbalance of the gestational diet, yet one cannot deny that excessive maternal and fetal gains have a deleterious effect upon mortality and morbidity rates by increasing the incidence of toxemias of pregnancy and birth injuries. The situation has been stated clearly by Cummings[74] who found that in women gaining 30 or more pounds during pregnancy operative deliveries and toxemias of pregnancy were 50 per cent more common than in women gaining 24 pounds or less. While the ability to control birth weight by dietary measures has been questioned by many,[75, 76] it seems probable that this is possible to some extent,[77] especially since the well-controlled studies of Toverud.[21] Regardless of the ability to affect birth weight by diet, frequent weighings, particularly in the last

months of pregnancy, may indicate occult edema from late toxemias of pregnancy or renal impairment, which if detected early may be corrected. Furthermore, excessive gains should make doctors suspicious of a latent diabetes that may be corroborated by glucose tolerance tests.[78] The caloric intake during the first four months of pregnancy need not be above average, but after this time rapid fetal development calls for an increased consumption of 20 per cent which in the last month should be augmented slightly so that the caloric intake is 37 calories per pound in twenty-four hours. The total caloric needs of an average-sized woman of sedentary habits during pregnancy and lactation is said to be about 2,500 to 3,000 calories, a demand usually met unconsciously unless she is led through perversion of taste, toxemia, or fad to adopt a deficient and imbalanced diet.

There should be a slight increased fat intake in the latter months of pregnancy. According to Kugelmass, fats are of value in increasing the bleeding and clotting times of the maternal and infant bloods.[79] Fats containing the greatest amounts of the fat-soluble vitamins such as butter fat, egg yolk, and cod liver oil are especially advantageous since they favor the absorption of calcium.

In the early months of pregnancy a high carbohydrate diet is said to be of value in reducing the severity of morning sickness. Later, excess of carbohydrates is contraindicated since it reduces the absorption of calcium[80] and seems to favor the development of the late toxemias of pregnancy and edema, as well as the incidence of dystocia from large babies.

The old idea that curtailment of proteins, especially in the latter months of pregnancy, was indicated does not fit in with modern ideas. It was based upon the assumption that the protein intake had a great deal to do with the development of renal complications. Experimentally and clinically this cannot be proved,[81, 82] in fact rigid protein restriction may be harmful.[83] High protein consumption seems to increase vigor and physiologic efficiency and to favor longevity,[84] as well as to prevent anemia and the tendency to bleeding.[79] Radical restriction of proteins will not prevent albuminuria and will make it necessary for the protein to be obtained from the body tissues with subsequent decrease of plasma protein and resulting hydremia and edema.[85] In the late toxemias restriction of salt is much more important.[86] A diet containing an ample amount of red meat and egg tends to maintain the hemoglobin content of the blood and to prevent maternal and fetal hemorrhage by shortening the bleeding and coagulation times.[79] At present an optimal rather than restricted protein intake appears to be in favor during the latter months of pregnancy or during lactation.[87] The usual excess of 100 grams in the form of milk, egg, and meat is advised.

Summary: If it does nothing else, the foregoing discussion will serve to indicate how involved and confused is the present-day conception about diet in pregnancy. In spite of this state of affairs one cannot help but be struck with the fact that the known facts are few enough to make the subject rather simple and the diet of the average pregnant American woman except in a few instances is adequate. A balanced diet is necessary in order to prevent the ill effects of malnutrition in the mother and infant with its associated increased inci-

dence of prematurity, stillbirths, and maternal and neonatal pathology. Certain generalizations can be made:

1. The caloric needs of the average gravid woman of sedentary habits are from 2,500 to 3,000 calories in twenty-four hours. (Fats, 50 to 100 gm.; carbohydrates, 400 to 500 gm.; proteins, 100 to 125 gm.)

2. The American diet is generally conceded to be deficient in calcium and phosphorus and the factor which causes them to be mobilized in the body, vitamin D. It is also highly probable that deficiency of iron, iodine, and vitamin A is rather common.

3. Rigid restriction of protein is unnecessary and probably harmful.

4. The diet should include: one quart of milk daily or easily assimilable calcium in some other form; one or two generous servings of green vegetables daily, spinach, cabbage, lettuce; one or two eggs or egg yolks daily; an apple or orange or some fresh fruit daily; sea fish twice a week and meat daily with liver once a week; and two teaspoonfuls of cod liver oil or its equivalent daily. The remainder of the diet may suit the desires of the woman.

II. *Anemia in Pregnancy*

During the first half of pregnancy there is an increase in the volume of the blood plasma (hydremia) with a definite reduction in the number of erythrocytes per cubic millimeter of blood. This is called the physiologic anemia of pregnancy. Actual anemia, that is, reduction in the hemoglobin content, manifests itself in the last half of pregnancy and especially in the last trimester when the fetus draws on the maternal iron supply for blood-building, muscle-building, and storage material to tide it over the iron-deficient period of early infancy.[88, 89] It is found in patients who for some time have not eaten enough iron-containing foods or have suffered from gastric anacidity.[90, 91] Such anemias, similar in some respects to pernicious anemia, can be prevented or cured by providing a diet rich in iron-containing foods. An abundance of red meats, egg yolk, liver, and green vegetables will supply this. Liver is particularly rich in the hemopoietic principle and should be given frequently when achlorhydria is present. There has been evidence pointing to the relationship of anemia of pregnancy with vitamin G deficiency,[92] but so far this has not been sufficiently corroborated. Prevention of anemia of pregnancy will make the maternal organism better able to cope with postpartum hemorrhage and bacterial invasion. Furthermore, as has been pointed out before, a high protein diet tends to shorten the coagulation and bleeding times of both the maternal and fetal blood. As far as the fetus is concerned the anemias of pregnancy apparently do not cause any lowering of the hemoglobin or erythrocyte counts at birth. However, an inadequate maternal supply of iron may result in a failure of the fetus to store enough to last it through the milk feeding period so that anemia will develop in the infant later. This is particularly true of the premature infant who usually has a low iron reserve. While clear proof does not exist as yet, there is evidence pointing to the fact that iron deficiency during pregnancy may be responsible for the common nutritional anemia of infants. This form of malnutrition in infants is of greater importance than might be thought, for they are more susceptible to infection and morbidity in general.[93]

III. *The Thyroid During Pregnancy*

The view that there is increased activity of the thyroid gland during pregnancy is substantiated by evidence of thyroid enlargement, increased iodine concentration of the blood, and an increased basal metabolic rate at this time. Soule[94] recently has corroborated the findings of others[95, 96] that the blood serum of pregnant women contains an increased amount of a substance that acts like the thyroid hormone, thyroxin. His studies seem to indicate that this high level of thyroid hormone is the result of an actual physiologic hyperactivity of the thyroid gland. It seems probable that the degree and the outcome of physiologic hypertrophy of the thyroid gland are dependent largely upon the supply of iodine in the maternal diet. When this contains sufficient iodine (0.1 mg. daily), the usual perceptible enlargement disappears after childbirth; but when it is deficient, a compensatory hypertrophy will appear and later hyperthyroidism may develop.[97]

Simple Goiter.—This usually does not interfere directly with the course of pregnancy as far as the mother is concerned but is indicative of an insufficient antenatal supply of iodine. Prevention of it by administration of iodine or perhaps thyroid extract may serve to decrease the incidence of congenital goiter.[98]

Hyperthyroidism.—It is fairly well proved that hyperthyroidism, whether a toxic adenoma or an exophthalmic goiter, frequently produces sterility[99] and seriously affects the normal termination of pregnancy by increasing the incidence of spontaneous abortion.[100] After the fourth month, pregnancy will probably go to term. In some instances thyrotoxicosis seems to be related to hyperemesis gravidarum and eclamptogenic toxemia by virtue of the fact that these conditions have been ameliorated by the use of Lugol's solution.[101] In the mild forms of hyperthyroidism in pregnancy, iodine therapy has been successful. Some have advocated small doses of thyroid extract, but its use requires close watch for the appearance of overdosage. In the severe forms thyroidectomy is advised regardless of the existing pregnancy, and in toxic adenomas early operation is advocated because the weakened heart muscle common to this condition may be unable to withstand the strain of labor.[102] The general consensus of opinion is that therapeutic abortion should not be performed because of the danger of precipitating a thyroid crisis. It now seems justifiable to permit patients with simple goiter or even mild hyperthyroidism uncomplicated by myocardial change to conceive provided that medical treatment is instituted during and after gestation and provided that the symptoms of the disease are carefully observed and controlled. In some instances the symptoms of hyperthyroidism are exaggerated by pregnancy; in others during the latter months of pregnancy when the patient is less active, the symptoms become milder;[103] and after delivery generally there is a considerable reduction in the severity of the disease. Pregnancy does not seem to be a factor in producing recurrent thyrotoxicosis after operation.

Hypothyroidism.—Thyroid deficiency probably plays a more important part in the causation of sterility, abortion, congenital goiter, and cretinism than is usually thought to be the case.[104] Administration

of adequate amounts of thyroid extract to hypothyroid women who have had recurrent abortions has made it possible for them to go to term in some instances. We have noted this in the case of some who have had hypothyroidism following operation. Marine's studies[105] indicate that simple goiter of the congenital type may be eliminated in a single generation by proper medication during pregnancy.[105] Continued treatment over several generations may be necessary to eliminate the hereditary factors associated with cretinism. Hanziker[41] states that endemic cretinism can be prevented if 0.1 mg. of iodine is taken daily in the first five months of pregnancy but that this may not be true for sporadic cretinism. The severest effects of hypothyroidism occur in fetal life. The nervous system may be irreparably damaged and some of the glands of internal secretion may be affected. This is particularly true of the pituitary gland, which becomes enlarged in cretinism and after thyroidectomy. Theoretically at least, maintenance of a normal thyroid should be of value in influencing the normal development of other endocrine glands. In order to recognize the mild degrees of hypothyroidism it is necessary to be on the lookout for the usual symptoms of thyroid deficiency and to check these with basal metabolism tests in suspicious cases. Treatment consists in the administration of thyroid extract or thyroid hormone throughout pregnancy and lactation.

Treatment: In view of the foregoing facts the importance of iodine to mother and offspring should be apparent if the maternal organism is to be protected from sterility, abortion, and simple or toxic goiter, or if the fetus and infant is to be protected from congenital goiter or cretinism. Milk, meat, bread, or the vegetables as a whole do not contain enough iodine but it may be augmented by the addition of sea fish or shell foods twice a week or daily doses of cod liver oil. Iodine may be given also in the form of iodized salt, but for those living in goitrous regions it may be necessary to give larger amounts in the form of organic iodine pills once a day or five drops of the syrup of hydriodic acid every other day. The danger that generalized use of iodized salt may increase the incidence of toxic goiter or be harmful to those with adenomatous goiters or definite hyperthyroidism is remote.[106] Davis[107] states that even if slight harm resulted, it should be given anyway in order to protect the fetus. In some cases of thyrotoxicosis, especially those associated with hyperemesis, Lugol's solution, from five to ten drops three times a day, is advocated.[101] While the use of thyroid extract is not limited to thyroid dysfunction, its administration in cases of simple goiter has not become common in this country.

IV. *Diabetes Complicating Pregnancy*

Before the advent of insulin diabetes mellitus did not constitute much of an obstetric problem for the majority of diabetic women of the childbearing age were sterile. Since then, however, owing to the apparent beneficial effect of insulin upon fertility, the incidence has been greater so that Bowen,[108] Skipper,[109] and Sherrill[110] have been able to collect over 100 cases of diabetes and pregnancy in the last decade. According to Skipper, before 1922 pregnancy occurred in only 2 per cent of diabetic women in the London Hospital as compared with 15 per cent in the series after this year. While an increased

number of early diagnoses may account for some of the cases, it must be conceded that the chances for conception are greater when insulin is used in treatment.

Pregnancy affects diabetes by lowering the sugar tolerance in the majority of cases although occasionally the tolerance is unchanged and in rare instances it is raised. Some have attributed the increased tolerance to a compensatory action upon the part of the fetal pancreas and have cited instances where it was necessary to decrease the dosage of insulin during the last few months of pregnancy.[111] In a case of one of my associates it was necessary to halve the dose of insulin after the fifth month, about the time the secretion of the fetal pancreas appears. Following delivery the original dosage was resumed. Immediately after birth some infants of diabetic mothers have developed hypoglycemia, i.e., hyperinsulinemia, which was treated by giving doses of glucose large enough to maintain normal blood sugar levels and to prevent convulsions.[112] Further evidence that there is at times a compensatory effort upon the part of the fetal pancreas is found in a few autopsy reports on human fetuses.[113, 114] In these instances there was hyperplasia of the pancreas, and on histologic examination there were three times the normal number of islets. According to most observers, however, such phenomena are uncommon, and the general view is that there is little tendency upon the part of the fetal pancreas to relieve maternal diabetes.

It has been commonly noted that the fetuses of diabetic patients are usually excessively large. Skipper found that 18 per cent of the infants weighed more than 10 pounds while Bix[78] found that 8 per cent weighed 9 pounds and nearly 11 per cent, more than 10 pounds. The latter believes that a moderate rise in the blood sugar level may stimulate abnormal fetal growth while a considerable elevation will tend to destroy the fetus. This would indicate that proper treatment of diabetes would save many babies. Bix also points out that oversize babies should lead one to suspect a potential diabetes in the mother. The same may be said for a tendency to habitual abortion or stillbirth.

Prior to the introduction of insulin the maternal mortality rate from diabetes was exceptionally high varying between 15 and 50 per cent during or shortly after birth and between 10 and 20 per cent in the succeeding two years.[115] The fetal mortality, including abortions and stillbirths, was usually close to 50 per cent. During the insulin era the maternal mortality rate has varied between nil and 9 per cent, depending probably upon the thoroughness of treatment. Maternal deaths are usually due to acidosis and coma rather than intercurrent infections. While the maternal mortality rate has been materially lowered by the institution of insulin treatment, the fetal mortality rate has not been affected appreciably, remaining well above 40 per cent. Fifty per cent of the fetal deaths are due to stillbirths and 35 per cent, to spontaneous abortions. Reduction in the fetal mortality rate can come only through rigid control of diabetes during pregnancy.

Skipper found over 50 per cent of the fetal fatalities were due to lack of rigid control of the blood sugar level in maternal diabetes. In the badly treated cases the infant was born dead a few weeks before term. When diabetes developed during pregnancy, the chances for a living child were distinctly greater. Owing to the fact that these infants tend to be excessively large there is a higher death rate from

birth injuries. Among the less common causes of death are hydramnios and congenital abnormalities, the incidence of both of which is increased in infants born of diabetic mothers. Deaths from hypoglycemia after birth are rare. Since hereditary diabetes is uncommon, there is little need for the diabetic mother to fear that her offspring will develop the disease.

Treatment of diabetes in pregnancy is practically the same as at any other period except that greater effort must be made to control the blood sugar level. Skipper states, "It is because the importance of rigid control of the blood sugar has not been sufficiently realized that the fetal mortality in insulin-treated cases has been so high." There is no reason to suppose that the fetal death rate cannot be lowered to nearly that of the maternal rate if diabetes is supervised more carefully. Apparently there seems to be greater danger from inadequate doses of insulin than from large doses. Carbohydrates should be given in quantities as large as the patient can tolerate easily. Usually from 125 to 150 gm. are sufficient. The most common complication is acidosis, which predisposes to premature labor and fetal death by decreasing the CO_2 combining power of the blood which in turn affects the normal placental interchange. Death of the fetus predisposes to maternal acidosis. With adequate treatment pregnancy does not seem to endanger the life of the diabetic patient. Lactation is not harmful, but usually the secretory power of the breasts is greatly reduced. Diabetic patients can be brought through labor safely, but operative deliveries are likely to be more common on account of the excessive size of the fetus.

From the foregoing it can be seen that diabetes in pregnancy is much more common than it used to be. While pregnancy aggravates diabetes, the maternal dangers are not much greater than for pregnancy uncomplicated by diabetes. However, so far the fetal situation is different, for in spite of the great reduction in the maternal mortality through the introduction of insulin the fetal mortality rate has not kept pace. This is due chiefly to improper control of the disease. Careful antenatal supervision should reduce the incidence of abortion, stillbirth, and premature labor, all of which are the result of laxity in the handling of pregnant diabetic women. The fact that the babies tend to be oversized may keep the mortality and morbidity rates somewhat higher, owing to the increased incidence of operative deliveries. The mother need not fear that her offspring will become diabetic. In some cases of recurrent abortion or stillbirth of undeterminable cause, a sugar tolerance test may indicate that the patient is potentially diabetic. The same may be said for the woman who bears an oversized baby.

V. *Infections*

Directly or indirectly, infections before and during pregnancy are responsible for a large number of maternal and fetal deaths, many of which could be prevented by more effective antenatal management.

Syphilis.—This disease has occupied a conspicuous place in the obstetric literature for years because of its deleterious effects upon both mother and infant. Untreated, it is a frequent cause of abortion and premature labor, the birth of infants with well-marked congenital syphilis, or the birth of those who fail to thrive and later in childhood

develop tardy symptoms of the disease. Still's figures[20] show that the incidence of mental deficiency is twenty times greater in congenital syphilis than in the rest of the population. The incidence of syphilis varies with the racial characteristics of the population.[116] Thus it has been found to vary from 1.2 per cent in Oklahoma to 34 per cent in the colored of Atlanta, Georgia. In general from 5 to 10 per cent of the clinic type of white patients have the disease while 15 or more per cent of the colored ones are infected. Regardless of the lower incidence among private patients, syphilis is sufficiently common and serious to warrant making every possible effort to detect it early, especially since the results obtained from early treatment are practically unparalleled in any other disease. A history of sterility, abortion, prematurity, deaths in infancy, or of syphilitic children can be obtained in from 50 to 60 per cent of infected multipara. While it is possible to make a clinical diagnosis in 25 per cent or more of the cases, serologic methods are productive of better results and should be used routinely in all classes of patients.[117] In view of the fact that nonspecific reactions do occur in pregnancy, the patient with a positive Wassermann reaction should be checked closely for clinical symptoms of the disease, and in their absence the test should be repeated. The use of umbilical blood for diagnostic purposes has given such variable results that it has been abandoned by many clinics. Gross examination of the placenta for syphilitic changes will reveal little unless the child is deadborn or obviously syphilitic.[118] However, a placenta that weighs over one-fourth the infant birth weight is considered definitely syphilitic.[119] Microscopic examination of the placenta is a most valuable diagnostic procedure. Since the syphilitic child often does not develop positive serology for several months after birth, other means must be taken to make a diagnosis. An exceedingly reliable method is roentgenologic demonstration of syphilitic osteochondritis in the long bones of the infant.[120] The disease does not seem to play much of a rôle in the causation of puerperal sepsis or maternal morbidity.[121] The effects on the fetus depend largely upon the virulence of the infection, maternal resistance, and the length of time the patient has had the infection. The longer the mother has had it, the less the effect upon the infant.[122] Since the treponema does not traverse the placental barrier early, the treatment of syphilis is uniformly successful if begun before the fourth month. Once the organism has gained entrance to the fetal circulation it is improbable that the fetus can be cured in utero. McKelvey[123] states that 78 per cent of syphilitic women treated before the fifth month bore living children while only 61 per cent bore living children when treated later and three times as many of these children were definitely syphilitic. Forty-nine per cent of the children of untreated mothers were stillborn, and among the living only 35 per cent were normal. Such figures emphasize the importance of making an early diagnosis and of instituting treatment immediately. If it could be recognized and treated before conception or at least early in pregnancy, the disease could be nearly eradicated in the fetus and newborn infant. The fact that the antisyphilitic metals are stored in the placenta in large amounts seems to indicate that they act more through preventing spirochetemia by destroying the organisms at the portal of entry than by any direct action on the fetus.[124] Treatment of the pregnant syphilitic woman differs little from that of the nonpregnant

syphilitic patient except that there is a somewhat increased incidence of arsenical reactions. Both results are obtained when treatment is instituted before or during the early months of pregnancy. Ten injections of both an arsenical and a heavy metal should be used. The habit of treating an infected infant for a few weeks after birth is of little value in eradicating the disease.

Tuberculosis.—From the limited number of cases reported from the different clinics the world over one would assume that tuberculosis is a rare complication of pregnancy. However, owing to the tremendous prevalence of the disease and to the fact that the majority of tuberculous women are in the childbearing age it is probably a common but frequently unrecognized complication of pregnancy. The lack of conspicuous symptoms or difficulties during pregnancy, which should attract attention to the possibility of tuberculosis, perhaps might indicate that the disease in many cases is not as serious as one would expect. The chief interest centers around the early diagnosis and the best way to care for it after pregnancy has supervened. Certainly the old view that pregnancy has a salutary effect upon active tuberculosis is untenable. While at first, owing to enforced rest, the patient may be improved temporarily, after the fifth month the disease usually advances more rapidly.[125] The controversy over whether therapeutic abortion is indicated in all active cases or whether a conservative attitude should be maintained is as yet unsettled.[126] Still others believe that no standard can be set and that each patient should be handled individually according to the various conditions that may obtain in her case.[127] While no definite conclusions that will settle all controversial questions have been reached, there is rather general agreement about some points. Abortion in the presence of a rapidly progressing infection from which there is no chance for recovery is unjustifiable. Under such conditions pregnancy should be permitted to continue in hopes of obtaining a living infant. If abortion is to be performed, it should be done before the third month, a fact which naturally excludes most of the patients seen later in pregnancy. When there is a good chance for recovery, two courses may be pursued. One is to empty the uterus immediately, and the other is to keep the patient under continual observation and to interrupt pregnancy at the first sign of change. The favorable reports coming from sanatoriums seem to indicate that a goodly number of recoveries will occur without interruption. The value of institutional care cannot be stressed too highly so that those who can afford it should utilize it by all means. When the woman's social status is such that she cannot receive proper treatment, institutional or otherwise, abortion would seem useless for she would die anyway. The danger of pregnancy in the woman with active tuberculosis is such that she should not become pregnant. If the disease has been of the fibrotic type and has been symptomless for two years, pregnancy may be permissible. Since placental transmission of tuberculosis occurs rarely, as a rule the offspring of a tuberculous mother is free from infection at birth although it usually possesses lowered resistance. It is necessary, however, to take the baby away immediately to prevent postnatal infection. If this is not done, about 50 per cent die in the first year and of the remainder the most die in the next two or three years. The babies are smaller and weaker than those of healthy mothers.[128]

Other Infections.—It is probably true that other infections play even a more important rôle in the causation of fetal and maternal mortality than tuberculosis or syphilis, but yet the literature contains little reference to them. Intercurrent infections in childhood and in the nonpregnant adult are responsible for many organic diseases which may seriously menace the life and health of the pregnant woman and her offspring. The pandemic of influenza in 1918 served to emphasize the disastrous effects of infection on gestation with its 27 per cent maternal mortality and 26 per cent incidence of abortion.[129] Similarly rheumatism, pneumonia, grip, diphtheria, scarlet fever, and many other infectious diseases are known to have an etiologic relationship to the complications of pregnancy. Certainly reduction of the incidence of these diseases and better management of them after their appearance would result in a wholesome lowering of the mortality and morbidity rates. Many believe that infection is an important factor in the etiology of abortion and stillbirth, and in this group must be classed the focal infections.[130] Toombs[131] in stressing the possible influence of focal infections in causing toxemias of pregnancy states that even those who deny that such infections are responsible for any of the complications of the gestation period are convinced of the importance of correcting such foci as abscessed teeth, diseased tonsils, and infected accessory sinuses. Since a considerable number of deaths from puerperal sepsis follow normal labors, it seems apparent that at least some women must become infected by organisms present in their own bodies. The fact that there is not a higher incidence of the disease is probably due to low virulence of some of these bacteria. Colebrook[132] finding that 42 per cent of his patients with puerperal sepsis had hemolytic streptococci in their throats suggests that the upper respiratory tract may be an important reservoir for the organisms causing this disease. Dunham[133] believes that unrecognized fetal infections are of more importance in neonatal morbidity and mortality than ordinarily supposed. She bases her conclusions on discovery that septicemia present at birth or shortly after was responsible for the death of a considerable number of infants in the neonatal period. Undoubtedly many other cases are overlooked because blood cultures are not taken. Similarly frequent reports of congenital pneumonia indicate that bacteria harbored in the maternal organism may be the cause of some of the apparently unexplainable infections at this time. Kaldor[134] corroborated the findings of others[135] by demonstrating histologically congenital pneumonia in one-half of the cases of stillborn and newborn infants showing no other cause of death. The infection is thought due to intrauterine aspiration in the majority of cases. There has been renewed interest in the old view that congenital heart disease was due to fetal endocarditis, owing to recent histologic evidence of the end-results of endocardial inflammation in the hearts of a number of infants dying of congenital heart disease.[136] The investigators believe that the infection must have occurred in utero. Meager as the reports of this nature are, they should serve to stimulate further study along these lines.

VI. *The Heart in Pregnancy*

During the last half of pregnancy the output of the heart is increased over 50 per cent[137] due either to actual hypertrophy[138] or to demands made upon the reserve force of the heart. These findings are sufficient

to warrant particular attention to diseased hearts during pregnancy and the strain of labor, especially since Stander[139] reports that one-fifth of cardiac patients show some sign of decompensation at these times. What can be done by proper management of the pregnant cardiac patient has been well described by Carr and Hamilton,[140] who were able to reduce the mortality rate from 12 per cent in the first few years of the heart clinic at the Boston Lying-In Hospital to 3 per cent for the last years. The fetal mortality rate including therapeutic abortions still remained high, 18 per cent as compared with 1.3 per cent for the whole clinic. They feel that in the great majority of cases maternal death among cardiac patients could be prevented if simple rules had been followed. This can be done by selection of good risks and the interruption or prevention of pregnancy in bad risks. Patients with a clear history of congestive heart failure or of existing failure are considered bad risks. A complication such as auricular fibrillation appearing in a patient with a severely damaged heart puts the woman in the class of poor risks. A recent attack of active rheumatic disease is a temporary contraindication for pregnancy. Since congestive heart failure is the usual cause of death, prevention of this complication is the keynote of proper antenatal care. It is due in most cases either to overexertion or intercurrent infection. If congestive failure is to be prevented in pregnant cardiac patients it is necessary for the doctor to outline specifically the daily régime for each patient and, furthermore, to see that it is observed. They should be examined at weekly intervals in order to check against overexertion and when a grippal infection appears, they should be forced to go to bed. This will assure them of being brought to labor in good condition, which of itself is most important, for few show failure or symptoms attributable to the heart during or following labor. Patients with heart disease do not, as is ordinarily supposed, have shorter labors. As a rule the delivery should be terminated as soon as dilation is complete, and if signs of decompensation are present before labor has begun or the patient is considered a bad risk for what will imminently be a prolonged labor, cesarean section is advised. One should avoid the general tendency to be too radical in the obstetric management of these patients.[141] In view of such reports it seems possible to make a decided reduction in the fetal and mortality rates provided that cardiac patients are managed strictly and carefully.

VII. *The Toxemias of Pregnancy*

The toxemias have occupied a conspicuous place in obstetrics for years because they contribute so much directly and indirectly to maternal and fetal mortality and because so little is known of the etiology. A recent survey has shown that 30 per cent of maternal deaths are preceded by some toxemia, and if only the last trimester of pregnancy is considered, that is, the time when toxemias are most frequent, the mortalities from sepsis and toxemia are equal—31 per cent. In 40 per cent of the surviving nephritic toxemias, Peckham[143] found evidence of definite nephritis a few months after delivery. The fetal deaths in this group, exclusive of neonatal deaths and cases in which the mothers died undelivered, were over 30 per cent.[142] The fetal mortality from the various toxemias, including abortions, Peckham found to be 53.8 per cent. In eclampsia alone it was 48 per cent. He be-

lieves that the fetal outlook is favorable in the milder toxemias but in the severer forms so poor that the infant's fate should not be considered in dealing with the condition of the mother. The chances of life for the live-born fetuses of toxic mothers is decidedly less. There are a greater number of premature births, the full-term infants are weaker, and their condition is relatively less satisfactory at discharge.[144] Proper prenatal care will do much to reduce the incidence of these toxemias, but until the cause and treatment has been absolutely established there will continue to be a considerable number of these cases. Formerly it was considered that prenatal care should prevent eclampsia but now it is thought that such care will only decrease the number of potential eclamptics of the convulsive type and increase the number of preeclamptics and nonconclusive types of toxemia, which, of course, are more amenable to treatment. There are numerous statistical examples of the value of antenatal care in abolishing the eclamptic type of toxemia. Thus Binder[145] reports that prenatal care and early recognition of toxemia halved the incidence of eclampsia and that the maternal mortality of those attending the clinic was 5.8 per cent as compared with 15.3 per cent for those who did not. Unfortunately, according to a recent study carried out by the Children's Bureau,[142] over 50 per cent of the women who died from the effects of childbirth toxemias had had no prenatal care, and only 12 per cent had received good antenatal attention. Such figures only go to show that in spite of the active propaganda of the last twenty years for adequate maternal care, actually very little has been accomplished. It is not within the scope of this discussion to include much about the treatment of the toxemias. There has been rather definite information regarding the value of diet in reducing the incidence of these disorders, especially in respect to restricting excessive gains in weight and attention to the intake of calcium, phosphorus, iodine, and vitamin D. This has been discussed already under nutrition. At the present time the majority favor conservative medical treatment rather than subjecting these poor surgical risks to the added burden of an operative type of delivery.[146] With such treatment Binder found that maternal mortality was reduced from 17.7 per cent to 7.7 per cent, while the gross fetal mortality was reduced from 44.3 to 27.1 per cent. It has been found that the postnatal follow-up of toxic patients is a most important adjunct to proper medical care.

CONCLUSIONS

1. Although it is true that maternal and neonatal death rates are too high, failure to recognize that it is difficult and often impossible to make statistical comparisons between two countries or areas has led to exaggeration of conditions and of the preventability of some of these deaths.

2. The fact that greater interest and activity in respect to antenatal care has not produced an appreciable reduction of total infant and maternal mortality rates, in spite of proof that it is possible in small groups, indicates that the present antenatal program is not comprehensive enough to reach the larger portion of the populace.

3. There is a vital need for closer cooperation between all groups involved so that a standard program based upon sound conservative

medical judgment and direction and adaptable to all classes and communities may be evolved.

4. All groups are open to criticism: the laity for indifference, an enthusiasm for dietary fads, and a desire for short and comfortable labors; lay agencies for a desire for overorganization, a tendency to stress superficialities or fads, and a tendency to encroach upon or dominate the medical profession; and the medical profession for indifference and the tendency to yield to the lay demand for operative methods, which in turn is partly the result of a trend among teachers to emphasize operative rather than natural labors.

5. The antenatal problem is primarily and essentially a medical one which can be solved satisfactorily only under sane conservative medical leadership and direction.

6. Although diet is becoming increasingly more important in the prophylaxis of many disorders of pregnancy, especially in respect to such food constituents as iron, iodine, calcium and phosphorus, vitamin D, and possibly vitamin A, yet this phase of antenatal care has not become so complicated that it cannot be handled by the physician.

7. There is evidence that the severe anemias and disturbances of the thyroid gland in both mother and infant can be prevented usually by proper dietary management.

8. Diabetes in pregnancy has become more common since the advent of insulin, and its correct management now assures both mother and infant a much greater chance for life.

9. Early and proper treatment of syphilis and possibly of tuberculosis will cause a notable reduction in the mortality rates, but there is need for greater interest in the prevention of other infections during pregnancy.

10. Recent methods of care have been productive of striking reduction in the danger of pregnancy in cardiac patients.

11. The toxemias of pregnancy continue to challenge the ingenuity of the medical profession, but attentive antenatal care, early recognition of toxemia, and sound and conservative midwifery have been proved capable of causing a considerable reduction in the incidence and mortality rates of these disorders.

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American Academy of Pediatrics

Proceedings

FOURTH ANNUAL MEETING OF THE AMERICAN ACADEMY OF PEDIATRICS

MONDAY MORNING AND TUESDAY AFTERNOON SESSION
JUNE 11 AND 12, 1934

Round Table Conference on Acute Infections

Leader: Dr. John A. Toomey. Assistants: Dr. D. Murray Cowie, Dr. E. J. Huenekens, Dr. H. T. Price, and Dr. Louis W. Sauer.

The Round Table on Acute Infections (Whooping Cough) was called to order at 9:45 A.M. at the Wade Park Manor Hotel, with Dr. John A. Toomey, Cleveland, Ohio, presiding.

CHAIRMAN TOOMEY.—The first speaker on the program today is Dr. Louis W. Sauer, associate professor of pediatrics, at Northwestern University, who will introduce the subject, "The Early Diagnosis of Whooping Cough."

The Early Diagnosis of Whooping Cough

L. W. Sauer, M.D., Evanston, Ill.

Long before the discovery of the etiologic factor, clinicians knew that the most contagious period of whooping cough occurs before the "whoop." Bordet and Gengou found the minute coccobacillus in a nearly pure state in the "pearls" of mucus, coughed up from the finer bronchi only early in pertussis. No other organism has been described as the cause of this disease during the past third of a century. Their bacillus has not been found in any other disease; nor are intimately exposed immune children likely to harbor it. Its habitat is the mucosa of the deeper parts of the human respiratory tract. Transmission occurs when expelled droplets containing bacilli are aspirated by nonimmunes. Because patients are seldom sufficiently ill to be confined during the catarrhal stage, they are usually not isolated during this most contagious period. Systematic use of the cough plate has brought evidence that this bacillus is disseminated in greatest profusion before the blood count or cough becomes characteristic. Although delay in diagnosis and quarantine is an important factor in its prevalence, the chief value of early diagnosis has been quite overlooked. To prevent or check its epidemic spread, exposed nonimmunes should be isolated before they, in turn, expose others. This important step in the evolution of epidemics should warrant the attention of health authorities.

Mauritzen suggested to Chievitz and Meyer of the Danish Serum Institute that colonies of the Bordet-Gengou bacillus should grow on Bordet medium held in

front of a patient's mouth during attacks of coughing. In 1916, their first publication on the cough-plate method of early diagnosis appeared. Satisfactory exposure of the culture medium,* sufficiently early in the disease, is the most important technical step. After a few sips of cold water, the aspiration of cigaret smoke by the patient will most frequently elicit the desired cough. The uncovered plate is held vertically, two or three inches from the open mouth, at the moment of several deep, expulsive coughs. Only properly exposed plates should be incubated. By daily examination of the incubated plate, rapidly growing saprophytes can be removed before they overgrow the minute, slowly growing colonies of *Bacillus pertussis*. The latter seldom become plainly visible with a hand lens before the third day of incubation. A well-developed colony approximates 1 mm. in diameter (Fig. 1). When viewed in reflected light, a definitely darkened zone is usually seen to surround each minute, round, markedly elevated, pearly gray colony. In transmitted light this area and the colony appear distinctly lighter than the surrounding medium. The soft colony can be quite completely wiped up with one sweep of the platinum

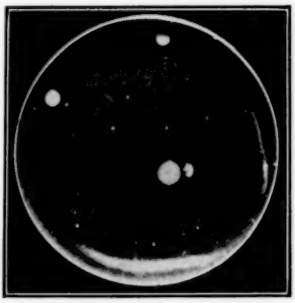

Fig. 1.

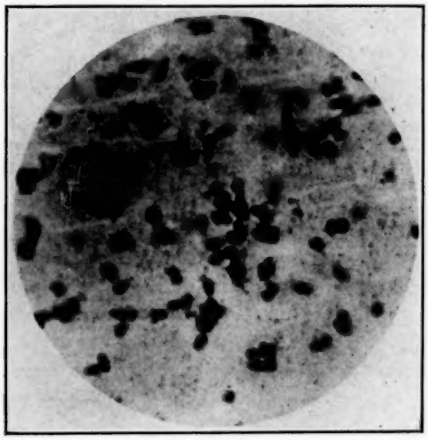

Fig. 2.

Fig. 1.—*B. pertussis* colonies with hemolytic zone. (Natural size.)
Fig. 2.—*P. pertussis*. Gram stain (negative) (×1750).

loop. In subcultures, the growth is usually rather luxuriant in from twenty-four to forty-eight hours. The organisms diffuse evenly when mixed with a droplet of water on a clean slide. Microscopic smears stain negatively by Gram's method. The carbolfuchsin counterstain should be left on longer than is customary, as the bacilli stain rather feebly. When first isolated, some of these minute, ovoid bacilli show bipolar staining (Fig. 2). In frequent transfers they usually appear more

*PREPARATION OF THE MEDIUM

Boil until soft 500 gm. of peeled, sliced potatoes in 1,000 c.c. distilled water and 40 c.c. of glycerin. Adjust to the original weight and strain through gauze. To 500 c.c. of the filtrate add 150 c.c. of 0.6 per cent salt solution and 60 gm. of agar. After the agar has been dissolved by heat (avoid scorching), adjust to the original weight, bottle in 150 c.c. amounts, autoclave and refrigerate.

Melt and medium, cool to 45°C., and carefully decant the upper 120 c.c. into 30 c.c. of sterile, fresh, defibrinated, human blood which has been warmed to 45°C. Gently and quickly rotate to mix medium and blood without air-bubble formation, and pour into sterilized culture bottles and Petri dishes before it congeals. The surface should be smooth and moist, the color a rich cherry red. Refrigerate until used. The poured medium should be used within from seven to ten days.

coccoid. Unlike *B. influenzae*, pleomorphism is rare in recently isolated cultures. Refrigerated cultures are usually viable at the end of a month, whereas, *B. influenzae* usually dies out before that length of time.

Although all who have mastered the cough-plate method of early diagnosis appraise it as a valuable aid, it is doubtful whether it will come into general use. Most patients are seen so late that diagnosis cannot be made from the cough plate. In such instances the blood (lymphocytosis), the characteristic cough, or the history of unquestionable exposure are the decisive factors in arriving at a diagnosis. Negative cough plates do not exclude pertussis nor is an early diagnosis of any therapeutic value. Promiscuous exposure of plates to every coughing nonimmune

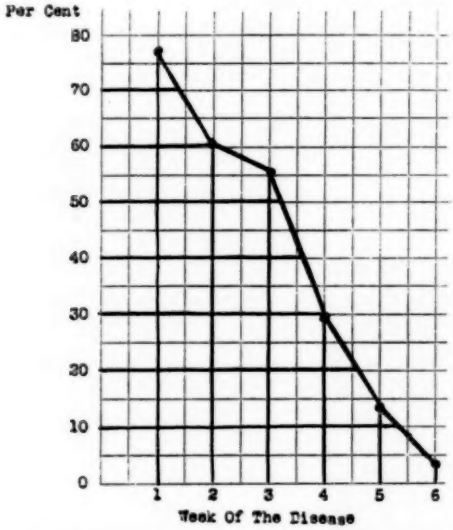

Fig. 3.—Cough plate—percentage positive in 4,432 cases of pertussis.

produces so many negative plates that the novice often abandons the method before the essentials of the technic have been mastered. The Bordet bacillus is an organism notoriously difficult to isolate and grow. The culture medium must be perfect,

TABLE I

COUGH PLATES—PERCENTAGE OF POSITIVE IN 4,432 CASES OF PERTUSSIS

AUTHOR	YEAR	NO. CASES	PER CENT POSITIVE FOR EACH WEEK OF THE DISEASE					
			1	2	3	4	5	6
Chievitz & Meyer	(1916)	914	75	57	61	45	40	9
Lawson & Mueller	(1927)	533	59	53	33	38	15	6
Sauer & Hambrecht	(1928-1934)	458	88	--	68	--	0	0
Gardner & Leslie	(1932)	47	75	67	75	25	0	0
Culotta & Harvey	(1932)	129	82	56	19	2	0	0
Kristensen, B.	(1933)	2,144	65	58	52	40	34	8
Kendrick & Eldering	(1933)	207	84	78	83	31	11	0
Totals		4,432	77	61	56	30	14	3

free from any substance which might inhibit its growth, and plates should not be more than a week old. Because the method is laborious, expensive and discouraging, the technician should be familiar with the vagaries of the technic, and the physician should resort to the method only in cases where the history and physical examination lead him to suspect the catarrhal or early paroxysmal stage of the disease.

Despite these numerous handicaps there have appeared, especially in recent years, quite a number of reports on the method. The findings of seven groups of workers are recorded in Table I. The percentage of positive plates for each week in a total of 4,432 cases of whooping cough shows that the earlier in the disease that plates are exposed, the more likely will they be found positive.

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DISCUSSION

CHAIRMAN TOOMEY.—I am sure some of you have questions to ask Dr. Sauer.

DR. VICTOR J. GREENEBAUM (CINCINNATI, OHIO).—Dr. Sauer mentioned the nonimmune cases. I should like to know what experience he has had with the skin test, using his own vaccine. A group of physicians in Cincinnati are testing the material and find that at the end of seventy-two hours there is a positive skin test for those who are not immune and a negative skin test for those who are immune.

DR. ELMER L. TIMMONS (COLORADO SPRINGS, COLO.).—How late after the beginning of whooping cough may the cultures still be positive? Have you had cultures past six or seven weeks that showed negative results?

DR. HENRY T. PRICE (PITTSBURGH, PA.).—Dr. Sauer mentioned the cost. I wish he would let us know the expense of this examination.

DR. EDGAR J. HUENEKENS (MINNEAPOLIS, MINN.).—I have tried this method on a small scale and ran into a great many difficulties that I think Dr. Sauer has not stressed sufficiently because he may not have run up against them. In the first place, it is very difficult to prepare the proper medium as it is difficult to get all the ingredients. The second difficulty is to get some one who is able to make this diagnosis; at least, I feel it is not quite as easy as Dr. Sauer has made out. He has trained experts who possibly do nothing else, but in our ordinary clinical laboratories workers have not been able to make positive diagnoses for us. I think it ought to be stressed that there are a great many technical difficulties and that it is necessary to be trained in order to do this bacteriologic work.

DR. GEORGE J. FELDSTEIN (PITTSBURGH, PA.).—The literature accompanying the Sauer vaccine suggests using 0.5, 0.7, and 1 c.c. doses of vaccine. The inference is that this is the way to treat whooping cough. From Dr. Sauer's paper I judge that he believes that pertussis vaccine is a prophylactic only, something like typhoid vaccine, and that the vaccine is of uncertain value in the treatment of pertussis. In Dr. Sauer's articles, he recommends the use of 8 c.c. as the total amount of the

vaccine, giving 1 c.c. in each arm the first week, 1.5 the second week, and 1.5 c.c. in each arm the third week. There seems to be a discrepancy in these statements. I want to ask Dr. Sauer whether or not he would consider the dose of 0.5, 0.7, and 1 c.c. adequate, or if he still insists on the total of 8 c.c. of his vaccine for immunity in treatment.

CHAIRMAN TOOMEY.—We will just limit this discussion to Dr. Sauer's paper at the moment and discuss Dr. Feldstein's question later.

DR. JOSEPH E. McCLELLAND (CLEVELAND, OHIO).—I would like to ask if bloods other than human have been used in the media for culture and if there is any difference in using human blood from persons who have had an attack of pertussis as distinguished from persons who have not had it. I would also like to ask if Dr. Sauer thinks that the Phases 1, 2, 3, and 4 of Leslie and Gardner could not be summarized into the smooth and the rough colonies and be simplified into the two types.

DR. W. AMBROSE McGEE (RICHMOND, VA.).—I enjoyed the paper very much. I have been interested in isolating the organism from patients for the past four years. The organisms were isloated by a very competent bacteriologist. He was very careful in preparing the media and in the way he took his cultures. He did the microscopic work himself and was able to find about the same percentage of positive cultures that Lawson and Mueller and Chievitz and Meyer found. Children do not always have severe coughing spells when you want them, so that unless you have some one trained to go around for you you have to rely on the parents.

I have tried to see if I could get cultures through the mail, but unfortunately they were shaken up so that it was not a practical procedure. Our media were prepared as Chievitz and Meyer suggested. The agar and potato extract were kept as stock solution, and the fresh blood was mixed with it, usually rabbit's blood, because we thought humans may have had whooping cough and that blood from them would have some deleterious effect on the whooping cough bacillus.

Personally, I do not think the cough plate is as valuable as the blood count. We tried the cough plate in 152 cases to see if we could get two negatives and release them as we do in diphtheria, but it is not practical. Too many of them were positive the third time. We found none in the sixth week and practically none in the fifth week. The big question which must be settled is the nature of the etiologic agent of whooping cough. Dr. Rich, of Johns Hopkins, thinks it is due to a virus.

DR. SAUER.—You can use any kind of blood for making the plates as far as diagnostic purposes are concerned, sheep, goat, or pigeon blood—the Japanese use pigeon blood—but for other purposes I think the best is human blood. One can use placental blood, taking it in sterile bottles.

As to the different types, the rough colonies get to be quite large, and we find the organisms under the microscope to be long like snakes. We hardly believe it is the bacillus that changes so when it enters that phase. It changes some when it enters that phase of the growth, but then you can keep it growing and get it back to the smaller size. This is all in line with the work of Dr. Hadley at Ann Arbor, who finds this organism like many others shows different morphologic types according to environment and stage of life cycle.

I am glad Dr. McGee spoke because a few years ago he presented a paper on the cough-plate method before the Section on Pediatrics of the American Medical Association. I am glad to know he is still doing that work. At that time I think he had 50 or 55 cases.

As to Dr. Rich's work, I will say the chimpanzee is by far the best animal for experimental studies, better than the macaccus monkey. McCordock in St. Louis started the virus idea in this country; hence it is nothing new. Joachim makes the same statement in his textbook on infectious diseases. To know the whole history one must appreciate the fact that Joachim's life work was the study of the pathology of pertussis. He described the organism just a year before Bordet and Gengou published their paper. From then on he took the stand that whooping cough is probably due to a simple virus although this idea never received much recognition. When Rich's work and McCordock's work came out, of course, that was quite a blow. I, personally, was absolutely convinced that the Bordet-Gengou organism was the etiologic agent because we were able to reproduce the disease in animals and could find the high blood count. The strongest argument I see is that you can immunize with the vaccine.

I have a friend who has four boys. Two of the boys are twins; one boy is older than the twins, and one boy, younger. Over a year ago, he said, "Immunize one of the twins and one of the other boys with the vaccine, and next June when they have their vacation, we will try to find out whether it is a simple virus or the organism."

I immunized the two boys. In June they went into quarantine in the country. I took one colony from a fresh cough plate and spread it over a Petri dish and incubated it. At the end of two days we scraped off completely half the surface growth, and suspended it in warm sterile salt from the time it was scraped off until it was instilled in the children's nostrils. This doctor dropped it into the nostrils of all four boys and had them gargle with it. We made blood counts, and nothing happened. After we thought we had waited long enough, I took one colony from the rest of that cough plate and made a suspension. In fact, we knew how many organisms were in a cubic centimeter because we sprayed some of it against a Petri dish. He gave each child about 160 organisms, one drop in each nostril, and after about nine days the mother noted that the two boys who had not had the vaccine coughed. The blood counts the next morning were negative. Cough plates were exposed to each boy, and we recovered more organisms in the two boys coughing at that time than we had given them. The plates were negative on the other two boys. We repeated that a number of times, about five in all. At no time were we able to grow an organism on the boys who had had the vaccine when the plates were exposed after we had gotten the first positive plates.

We had the one twin who had had the vaccine put his head right beside the other one who was coughing at the very time we exposed the cough plate. Then we would have them kiss each other and expose the cough plate to the other one. We never could get an organism from the other one. The blood count gradually went up and reached at the highest point over 29,000. The cough in three weeks progressed, and they whooped and vomited and were sick. They had râles in the chest, and one boy probably had a little localized bronchiolitis, but they made very nice recoveries; upon complete recovery we made complement fixation tests on all four boys. The technician who made the blood counts knew nothing about what these blood counts were. They were not made by us.

DR. McGEE.—Did you make blood counts on the two who had been vaccinated?

DR. SAUER.—Yes. They were all normal.

DR. McGEE.—How quickly did the counts go up?

DR. SAUER.—About the twelfth day of coughing.

DR. S. P. WAINWRIGHT (BIRMINGHAM, ALA.).—Did you make fixation tests before you started?

DR. SAUER.—Yes, and on controls. So the experiment not only proves that the vaccine immunizes, but to me it proves that it is not due to simple virus. The blood count is not positive very early.

In regard to the skin tests, Dr. Earle knows how hard we tried to get a skin test about five years ago. At that time the Dicks tried to give us advice to grow the organism in broth for a long time, then filter it, and then try various dilutions of the filtrate in nonimmunes and immunes, and make readings. We pursued that for about a year. Dr. Earle has a wonderful institution where this kind of work might be tried although the children are a little old. To our great disappointment our results showed nothing consistent.

I think this might possibly be explained partly by the fact that during that next summer six cases of whooping cough broke out in various parts of the institution, all at the same time, and no new cases subsequently. In other words these children—we did the tests on hundreds of them—were all immune. This year I felt we had to work out a skin test. We have been working on the filtrate, in fact, on the centrifuged, clear fluid of our vaccine, feeling that the blood is so infiltrated in the liquid of the medium that the reactions are rather hard to interpret, that the reactions may be due to other proteins.

We made other tests using both solutions with the hope that the toxin or antitoxin would be present in dominating amount, and that the protein of the bacterium would not interfere with our readings, but that is not the case. We get positive tests in both groups of children, immunes and nonimmunes, using vaccine or dilutions of the various kinds. We are not prepared to make any definite statement.

As to the price of the medium, it is really not expensive. It is nothing but potatoes, agar, salt and water. We make up the stock culture medium and put it in the ice box in small bottles. That basic medium is melted up and fresh defibrinated human blood added. The laboratories around the city are willing to cooperate and make up the medium.

My technician and I went together on the same trip, and she took my plates along so that they were exposed at the same time. Technicians must be trained. This year I had a new one, and for two months I could not get a positive plate. I found it was the agar she was using. Instead of using long agar she was using flocculent agar. Some ingredients seem to inhibit the growth.

I think one trained technician in any community would be sufficient, especially if doctors would make use of the culture medium on hand. Of course, pertussis is an epidemic disease. They should make only enough to last from week to week and keep only a few plates on hand so that they can get them when needed. The same person who makes the culture medium should be the one to examine them. Our technician is well trained now and when I exposed the plates for eight or nine cases, every one gave positive results. Before that, for two months we could not get a positive plate.

CHAIRMAN TOOMEY.—Dr. E. J. Huenekens, associate professor of pediatrics, University of Minnesota, will now introduce the next subject, "The Use of Vaccines in the Prevention of Whooping Cough."

The Use of Vaccines in the Prevention of Whooping Cough

E. J. Huenekens, M.D., Minneapolis, Minn.

One of the very controversial subjects in pediatrics is the value of pertussis vaccine. There is a difference of opinion, first, as to whether it is ever of any value and, second, if valuable, at what stage of the disease it should be administered. It is generally acknowledged that the vaccine has practically no effect in the paroxysmal stage of pertussis. Many hold it to be of some benefit in the early catarrhal stage; the majority of those who favor it recommend it after exposure and before symptoms develop while there are those who doubt whether it has any value under any conditions. Because of the limited number of cases seen by any one observer and the lack of proper controls, the results obtained by pertussis vaccine are difficult to evaluate. The fact that absolute proof of its efficacy cannot be obtained is not a sufficient reason why it should not be employed by an intelligent and conscientious physician. In the absence of any other preventive remedy, a reasonable amount of evidence of its value may warrant its continued use until new evidence against it is obtained or until a more effective prophylactic agent is discovered. Let us examine the evidence.

Theoretically, laboratory experiments justify the use of pertussis vaccine. Huenekens[1] was able to demonstrate that pertussis vaccine produces immune bodies, as shown by the complement fixation test; freshly prepared vaccine was the most effective. Later Mishulow, Oldenbusch, and Scholl[2] showed that old pertussis vaccine, properly prepared, preserved, and stored, retains its potency for several years. Unfortunately, their work is not wholly conclusive because it was performed on rabbits and not on human beings.

It has been contended that pertussis vaccine would protect against only one strain of the Bordet-Gengou bacillus, but Leslie and Gardner[3] present evidence that the pertussis bacillus is a uniform species without fixed types. So much for the laboratory side.

The clinical evidence regarding pertussis vaccine is conflicting, and most of it is of doubtful value because of the small number of cases and the lack of adequate controls. Rietschel[4] in 1930 reported an epidemic of pertussis in an institution. The epidemic was promptly stamped out by the prophylactic injection of pertussis vaccine in four doses of two, four, six, and eight billion bacteria. His enthusiasm prompted a number of German pediatricians to give it a trial; the majority found it of prophylactic value, but a few reported negative results. One of the latter, Grüneberg,[5] relates his experience in a children's ward where four cases of pertussis developed. When, after some delay, the diagnosis was established, ten of the exposed children were given protective doses of vaccine, while the remaining fifteen received none. No further cases of pertussis developed, and the author rightly points out that if all had received the injections, it would have been hailed as a triumph for pertussis vaccine.

In his latest report, Rietschel[6] warns against too great enthusiasm and argues that in older children the good results of the vaccine may be due to psychologic effect. He further requests that all German cases in which the vaccine is used be reported to him with complete details so that an adequate number of cases may be collected and coordinated.

The most favorable and best controlled clinical observations, however, come from Madsen,[7] who reports two epidemics in the Faroe Islands. The isolated position of these islands cause the whooping-cough epidemics to appear in waves, separated by quite long intervals entirely free from whooping cough. In the 1923-1924 epidemic, 2,094 individuals were vaccinated, and 627 received no vaccine. The prophylactic

effect of the vaccine was practically nil, but the mortality in the nonvaccinated group was twelve times that in the vaccinated, and the disease in the latter group was much milder and of shorter duration.

In a second epidemic in 1929, the results were more striking. Of the 1,832 vaccinated individuals, 458 did not contract the disease, and only one died; while of the 446 nonvaccinated, only eight escaped pertussis, and eight died. The mortality was thirty times greater in the nonvaccinated group, and there were sixteen times as many severe cases.

TABLE I

MADSEN'S ANALYSIS OF 1929 EPIDEMIC

	1,832 VACCINATED	446 NONVACCINATED
Not attacked	458	8
Mild cases	1,336	225
Moderate cases	29	170
Severe cases	8	35
Fatal cases	1	8

The vaccine used was from the State Serum Institute in Copenhagen, where it is always made from several recently cultivated strains of Bordet-Gengou bacilli; forty-eight-hour blood agar cultures are emulsified in physiologic salt solution containing 1 per cent formaldehyde and numbering ten billion bacilli per cubic centimeter.

According to Madsen, the favorable results were due to the following facts:

1. The vaccine was made from young strains.
2. The dose was rather large, twenty-two million bacteria.
3. The vaccination was completed shortly before the onset of the epidemic; i.e., at a time when the titer of antibodies produced by the vaccine is highest.

If we had no other evidence, these reports of Madsen would justify the use of pertussis vaccine, partly to prevent the disease, but especially to reduce the mortality of pertussis and to decrease its severity.

Favorable as is this report, it does not solve the problem of permanent pertussis immunization. We must give credit to Sauer[8] not only for being the first to attempt this, but also for his apparent success. Sauer prepares his vaccine largely accord ing to the Danish State Serum Institute specifications, the principal difference being that he uses human blood for his blood agar culture plates. I can give no clearer picture of Sauer's accomplishment than to quote the summary in his most recent publication:

"*Bacillus pertussis* vaccine (1 c.c. = ten billion bacteria) made from recently isolated, strongly hemolytic strains, grown on Bordet-Gengou medium made with freshly defibrinated human blood, has been injected as an immunizing agent in 394 selected nonimmune subjects. The total of 7 to 8 c.c. (seventy to eighty billion bacilli) is divided into three weekly (bilateral) injections of 1, 1.5 and 1.5 c.c., respectively. In the course of five years, thirty-one control children in twenty-four of the families contracted unquestionable whooping cough. Twenty-nine of the injected children were exposed throughout the incubation, catarrhal, and paroxysmal stages, but none contracted the disease. Not one of the 162 injected children accidentally exposed has had a cough that in any way resembled pertussis. Active immunity is completed in four months and lasts for years. Infants withstand the injections remarkably well. The best age for immunization is the second half-year of life."

Before we can accept Sauer's work as a final proof of the possibility of establishing permanent immunity to pertussis, we must have observations on a larger number of children for a longer period of time, and the work must be confirmed by independent observers. But, in the meantime, Sauer has presented evidence enough so that the conscientious physician is justified in advising the procedure for his patients, provided that he warns them that final proof is lacking.

Both Madsen and Sauer stress the importance of stringent care in the preparation of the vaccine; both emphasize the importance of obtaining recently isolated strains of Bordet-Gengou bacilli. Both advise large doses; Madsen, twenty-two billion, and Sauer, seventy to eighty billion.

Keller and Klopstock[9] and Gundel and Schlüter[10] give warning that while *Bacillus pertussis* can be absolutely identified by bacteriologic and serologic methods, if painstaking care is not used, similar organisms, such as the influenza bacillus, may be mistaken for it. In the past, some of our pertussis vaccine may not have contained Bordet-Gengou bacilli.

Krueger, Nichols, and Frawley[11] have recently reported a new type of undenatured pertussis vaccine which, theoretically, should have a higher antigenic value than the older type of vaccine, but it must be subjected to rigid clinical test before it can be accepted.

A word as to the possible danger from pertussis vaccine. Sauer mentions an occasional rise in temperature, temporary local reactions (redness, induration and tenderness), and subcutaneous nodules which may persist for a few weeks at the site of each injection.

Madsen reports the death of two newborn infants following two injections of the vaccine and advises that it not be administered to children under one month of age. Other than these, he encountered no severe reactions in over 4,000 cases.

To summarize, the evidence presented warrants a clinical trial of Sauer's method of permanent immunization against pertussis. If a child has not been immunized and is exposed to the disease, he should receive pertussis vaccine between the time of exposure and the onset of symptoms in an attempt to prevent whooping cough, but in any case to decrease its severity and reduce its mortality.

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DISCUSSION

CHAIRMAN TOOMEY.—Are there any questions or discussions on this paper, any questions about vaccine?

DR. TIMMONS.—I would like to ask Dr. Huenekens what experience he has had with this new preparation of Dr. Sauer's, and has he used the preparation put out by Eli Lilly and Co. as a prophylactic after exposure and as a treatment beginning immediately after exposure?

DR. GREENEBAUM.—The governmental statistics show that the highest mortality occurs in the first year of life. I have had several children under three months of age who have had whooping cough. If it takes four months for the immunization to take place after the initial five doses have been given a week apart, a child given the vaccine at the age of one month will not be immune until six months of age. I think that is not going to help those infants in the first year of life. I'd like to know whether any work has been done on the question of immunizing the pregnant mother as one of the prenatal prophylactic measures.

DR. PASCAL F. LUCCHESI, PHILADELPHIA, PA.—I would like to know if Dr. Huenekens has had any experience with a substance, known as the soluble antigen, now being used in Philadelphia, for its therapeutic value. It is used by instilling two or three drops into the nose every other day for three or four treatments. Some people in Philadelphia are very enthusiastic. I am now trying it at the hospital. I wonder if you have had some experience with it.

CHAIRMAN TOOMEY.—Dr. Earle wants to know about the expense of the vaccine. Are there any further questions?

DR. CHARLES W. MARTIN (FAR ROCKAWAY, N. Y.).—I should like to know whether the experience has been better with the pure culture or with a mixed culture of different germs, from a standpoint of prevention of complications. I have been using a mixed vaccine, and I feel that I have fewer complications with it. I should like some one of greater authority to tell me whether he feels the same way or not.

CHAIRMAN TOOMEY.—Dr. Huenekens, will you close?

DR. HUENEKENS.—About the dosage—so far as I know, Dr. Sauer does not recommend his vaccine for anything except permanent immunization; consequently, he has only the dose of 1, 1.5 and 1.5 c.c. I think I agree with Dr. Madsen that the vaccine has other uses when given between exposure and onset of symptoms. I think Dr. Sauer has recommended the vaccine only for permanent immunization. I think it could be used in the smaller dose, such as Dr. Madsen has used, if it were given the other way. Dr. Madsen uses only 22,000,000 between the time of exposure and onset of symptoms. As far as I know, the only firms making Dr. Sauer's vaccine are Eli Lilly and Co., and Parke, Davis Co., who are going to bring it out shortly.

Speaking of the soluble antigen and the new vaccine of Dr. Krueger, I think Dr. Krueger's vaccine is on a very sound theoretical basis. Dr. Krueger has carried some work that was done by Larson of Minnesota. Larson, years ago, decided that one of the troubles with the ordinary vaccine is that the latent bacteria, not crushed, did not have as great antigenic value as bacteria that had been exploded. He developed a method by which he could explode the bacteria. Dr. Krueger also worked out a method by which the outer coating of the bacteria is crushed and demolished; he feels it has greater antigenic value, but I think the only test is the clinical test. We can't say anything about soluble vaccine or any other vaccine until it has been given a thorough test. I have not used Dr. Sauer's vaccine in enough cases or long enough to feel competent to say anything about it. I said in my paper that even Dr. Sauer's observations, including the number of cases and the length of time, are not final and I think we should still have a skeptical attitude about it. It must be used in a larger number of cases over a longer period of time by entirely independent observers. I do not question Dr. Sauer's work; I am very enthusiastic about it, as a matter of fact, but I do not think we should accept it as final. There is no evidence from anyone except Dr. Sauer at the present time.

As to Dr. Greenebaum's question about immunizing the mother by giving her pertussis vaccine—that has not been done at all. It is something worth thinking about.

I would like to say just one word about something outside my subject. The subject of the skin test was brought up. Theoretically, I should think the skin test ought to prove negative in pertussis because no one has proved there is a real exotoxin. In all skin tissues there is a real exotoxin aside from the toxin that has the effect.

As to the price, Dr. Sauer tells me the cost of each treatment is $1.50.

I want to defend Dr. Sauer's work against himself. I think making an early diagnosis is of importance, not to the patient himself, but for the other exposed members of the family. I think that is important and we can do something for the other exposed members if we can make the diagnosis early on the first case in the family.

DR. JAMES W. BRUCE (LOUISVILLE, KY.).—How long after the series of immunization treatments is it before you feel a child has developed immunity?

DR. S. P. WAINWRIGHT (BIRMINGHAM, ALA.).—I'd like to know if there is any possibility of allergic reactions that might injure the patient in any way; if this marked redness of the arms that sometimes occurs might not be an allergic manifestation, or if anyone has had any serious results from giving these injections.

DR. McGEE.—I have not had any experience with Dr. Sauer's vaccine, but with the vaccine I have been able to get on the market, I certainly have had results that were not what I wanted.

I recall some forty children whose mothers thought they had whooping cough from the type of the cough and from the fact that there was an epidemic in town. Having no faith in the vaccine, I asked the mothers if they would let me watch those children for a period of a week or two to see if they developed whooping cough; in the great majority of cases they did not develop it. Had I given them any kind of vaccine I would have been very enthusiastic as to the potentialities of whooping cough vaccine as a prophylactic measure. I remember reading in Mishulow and Oldenbusch's work that some people never have pertussis. I think this tracheitis just mentioned is frequently confused with whooping cough, the main difference being that it starts off severely, is no worse in the daytime than at night, and is not progressive like pertussis. I believe it is called pseudopertussis in the European countries. Some twelve children in Richmond were given several doses of vaccine, and all of them developed whooping cough.

In reference to the mortality, I have seen only one death from whooping cough, a premature baby, who was given every measure commonly used, such as vaccine, ether, mustard plasters for the bronchopneumonia, whisky, etc.

Fawley says some of his children developed pertussis. All of us realize that at different times, different seasons, different years, we have different severities of infections. Sometimes it might be very slight.

My objection is that I have seen no consistent or striking results in the cases in which vaccine has been used, and sometimes one gets a false idea of security if a preventive vaccine is given and it is found later the child did not have the disease.

DR. McCLELLAND.—I'd like to ask Dr. Huenekens if he has tried giving a single dose in the buttocks for the three inoculations instead of dividing the dose and giving half in each arm, and if he sees any objections to that method of administering the vaccine.

DR. E. G. SCHWARZ (Fort Worth, Texas).—I'd like to know if the commercial vaccines on the market at the present time are made according to Dr. Sauer's recommendation; whether the commercial vaccines are affected by transportation into a warmer climate; and whether their potency would be destroyed.

DR. WILLIAM N. BRALEY (Highland Park, Mich.).—I was particularly glad to hear Dr. Huenekens' paper because a few years ago I heard one of his first papers on whooping cough. At that time, as I remember, he felt that vaccine in whooping cough was of no avail. His conclusion at that time was that it was of benefit in about 30 per cent of the cases. I would like to ask Dr. Huenekens if there have been any blood studies made before and after the use of the vaccines in whooping cough.

DR. FRANKLIN P. GENGENBACH (Denver, Colo.).—We have used Dr. Sauer's vaccine in a number of cases with very good results in preventing the onset of whooping cough. It is our practice to give the straight pertussis vaccine in increasing doses, and, while we have not been able to prevent the onset of whooping cough, we certainly have modified it very materially. In the patients who come to us with whooping cough, we combine the pertussis vaccine with a mixed respiratory vaccine or a respiratory serobacterin. In those cases we feel that we have modified the severity of the disease. We have not lost any cases.

DR. GEORGE H. FELLMAN (Milwaukee, Wis.).—I have been using vaccine for quite a number of years. I recently began using Dr. Sauer's vaccine as a preventive. I have not had a sufficient number to form an opinion. As far as the mixed vaccines are concerned, in my own experience I believe about 33 per cent of those cases in which they were used have shown a reduction in the number of paroxysms, and the duration of the attack has been shortened in about the same number.

I don't know whether Dr. Huenekens has used any of the vaccine Dr. Larson prepares freshly every month. I used that some years ago, and I thought I got about the same percentage of benefit in the use of that vaccine.

CHAIRMAN TOOMEY.—We will ask Dr. Huenekens to close.

DR. HUENEKENS.—I began my remarks with a statement that it was a very controversial subject. I guess it still is. It takes about four months before immunity is developed. I think we have no good evidence except Dr. Sauer's. He is the only one that has used the vaccine long enough for results to have any value. I have not used it long enough to know anything about it.

As far as I know, these reactions are not allergic reactions at all, but purely chemical local reactions, which do not cause permanent trouble outside of two cases reported by Dr. Madsen, in which two infants died. Autopsies were performed and the cause of death was not found. They were very young infants, one being premature. They had vaccinated any number of infants with no bad results, but after that they stopped doing it until the infant was a month old.

Dr. McGee spoke about using the commercial vaccines. I think it makes a great deal of difference what vaccine we use. There are all kinds of pertussis vaccines. Up to the present time the method used by the Danish State Serum Institute is very good. A complete census of all Danish physicians who have used it for a number of years shows these physicians are convinced it is of considerable value in the early catarrhal stage. We must not only consider the type of vaccine but the dosage. They are using a tremendous dosage. We are not using so much. Theoretically, I think the new vaccine brought out by Krueger is the best type of vaccine.

With all due respect to Dr. McGee, I think the few cases in which he claims he used it do not make his experience so very important—nor is mine, nor is anybody else's, because we have not had enough cases. I rest my case on the report of Madsen. I think he is the only one who has used it in a large enough number of cases for us to be sure of the value of the report. The peculiar condition on the Faroe Islands makes it like one great, big institution. He had altogether 4,000 cases within one institution. His work, is seems, is conclusive. In certain cases maybe the vaccine does not prevent at all, but it certainly modifies the disease and cuts down the number of deaths. Before they vaccinated, they had from 12 per cent to 30 per cent deaths.

Dr. McClelland asked about using the dose in one spot instead of in both arms. I have had no personal experience with that method. As far as I know, there is no objection to it except possibly a greater local reaction.

Dr. Schwarz' question as to shipping commercial vaccine is very important. It must be kept cold all the time in order to retain its potency, and shipping would not make any difference if it could be kept cold. If it is kept in a warm place, it deteriorates very rapidly.

In answer to Dr. Braley, there has been quite a bit of work done on the complement fixation test to show that after the vaccine there is a specific reaction, and that vaccine produces the same antibodies as the disease itself. Theoretically I think there is abundant proof that this is a specific reaction and not just a protein reaction.

I have had no experience with mixed vaccines. It is hard enough to judge the value of the straight vaccine without complicating it with the mixed vaccine.

DR. D. MURRAY COWIE (ANN ARBOR, MICH.).—Does it not take four months to get immunity?

DR. HUENEKENS.—It does for the Krueger method.

Rietschel said in some of the older children the psychologic effect may be great. I do not think there was any psychologic effect in Madsen's having thirty times as many deaths in the unvaccinated group.

DR. NORMAN C. BENDER (BUFFALO, N. Y.).—Do you use Sauer's vaccine therapeutically?

DR. HUENEKENS.—Yes, and as far as my limited experience has gone, I think it has acted at least as well as any vaccine I have used before—probably better. It has been so short a time that I would not care to state the results.

DR. BENDER.—What are the therapeutic doses?

DR. HUENEKENS.—Therapeutically I used it just the way Madsen did, twenty-two billion bacteria. I don't see why you could not use just as big a dose as Dr. Sauer has in his immunization.

DR. McGEE.—In how many injections do you give the twenty-two billion?

DR. HUENEKENS.—Usually three.

CHAIRMAN TOOMEY.—Dr. Sauer, will you answer the one question left unanswered, about giving the injection in one spot instead of two?

DR. SAUER.—I think the worst place you could pick out would be the buttocks. One doctor had been telling the mothers when they took the children home to put warm, wet dressings on, and in about half the cases there were abscesses. He called me up and said he thought the dressing would make the injections less painful for the children. I told him to stop putting wet dressings on and if he

had more abscesses to let me know, but he didn't have any more. The moisture of the diaper might work the same way. I think the arm is the best place.

DR. McGEE.—Can you give a double quantity in one arm?

DR. SAUER.—I have never done it. I divided it because in the first hundred cases I tried out I gave them one shot a week for eight weeks. The reactions were so slight that I just doubled up and used both arms. The reactions were no worse. Since then I have put it all into three injections. We have enough trouble when we let a commercial firm make the vaccine. Carrying it around in your bag may harm the vaccine. I have never done that. As soon as a shipment comes in, we put it right in the refrigerator at once; I keep some in the refrigerator in the hospital, my home, and office, and never carry it around at all. It is bad enough to transport it for a few days; I think it should be kept cold.

DR. WAINWRIGHT.—When this vaccine is shipped from one point to another, is it kept in refrigeration?

DR. SAUER.—I do not know. It is sent by mail.

CHAIRMAN TOOMEY.—The topic I am to introduce is "Recent Experiments in Whooping Cough."

Recent Experiments with H. Pertussis

John A. Toomey, M.D., Cleveland, Ohio

Years ago, Bordet and Sleeswyck[1] described the whooping cough bacillus as being present in either of two states, depending upon the medium on which it was grown. Later, Krumwiede, Mishulow, and Oldenbusch[2] demonstrated the presence of two types or strains of this organism. Still later, Leslie and Gardner[3] showed that there is only one strain of the bacillus which may be found in various conditions which they termed Phases 1, 2, 3, and 4. The inference was that all pertussis organisms could be grouped under these various phases.

This fundamental conclusion had to be independently repeated and the conclusions tested. We have been doing this work in our laboratory for the past three or four years, and since our work has been finished, a preliminary report of our conclusions might be interesting to this group.

To begin with, we agree with Leslie and Gardner, and incidentally with Bordet and Sleeswyck, that the whooping cough bacillus is a single entity and that it may be found in various phases, but we do not agree with Leslie and Gardner when they state that these phases are distinct enough so that all organisms could be specifically grouped under those four heads. We conclude, just as Bordet did, that the whooping cough bacillus has two states of being, namely: State 1, which we would be inclined to call the disease-producing state of the organism (the same as Phase 1 of Leslie and Gardner) and State 2, the resting or the nondisease-producing state of the organism. All of Leslie and Gardner's Phases 3 and 4 would belong to this group. The four phases Leslie and Gardner have described would be totally insufficient to account for all the types of organisms that may be found.

In our work we also found that the organism in the resting or nondisease-producing state is distinctly different from one in the disease-producing state both in virulence and antigenic qualities. The freshly isolated strains show remarkable powers of producing agglutinins and are extremely virulent for guinea pigs. On the other hand, the resting state organisms have poor agglutinin production qualities and are many times less virulent than the disease-producing strains. We have shown that the old isolated organisms or the resting-phase organisms will not produce the

disease in *Macaca rhesus* monkeys while Sauer and Shibley have shown that the freshly isolated strains or the disease-producing organisms will do so. It is not necessary to burden you with details of absorption and cross-absorption experiments of freshly isolated against old isolated serum strains, etc. This work will be fully reported later. We mention it here to indicate the fact that our work has other substantiations to enable us to conclude that all strains could be said to be in a resting or a disease-producing state of the organism's existence.

There is also a definite morphologic difference between these two groups. In the disease-producing state, the organisms are coccoid, small and dotlike; while in the resting stage, they are safety-pin shape, much fatter and sometimes from five to ten times as large as the disease-producing group of organisms, definitely indicating that this organism is a bacillus having marked variations in size.

Grossly, also, there is obvious difference when the organisms are grown on media. On blood agar, the disease-producing organisms appear rounded, globoid—like mercury drops—with a slight zone of hemolysis about the periphery, while the colonies of the resting-state organisms appear flat, dry, and irregular edged without a hemolytic zone.

The difference in the states of the organisms is brought about by the type of the medium employed. When a stock strain organism is always kept growing on blood agar, it loses but little of its antigenic and virulent qualities even after a year and a half of growth. It practically reverts to a resting-stage organism, however, after growing for ten or fifteen generations on either plain or veal brain agar. This is curious in view of the remarks made about freshly isolated strains. It indicates that perhaps a little too much importance is placed upon an absolutely freshly isolated strain and that perhaps more emphasis should be placed upon the fact that a strain should always be carried on blood medium if it is to be used for virulent or antigenic qualities.

The resting-phase organisms which really correspond to the "R.," or rough strain, of an organism may be brought back to a "S.," or smooth strain, either by injecting a guinea pig intraperitoneally with a saline suspension of the organism after which a virulent and highly potent antigen-producing organism may be recovered, or the organism may regain these characteristics by subplantation on a blood agar medium any time after from the third to the fifteenth subplant.

Bordet's original contention that there were only two states of the organisms is still true. We might call these states a resting, or nondisease-producing state, and a disease-producing, or virulent state. He specified years ago that freshly isolated strains are the ones to be used for the production of antigens and this has again been confirmed. His original observations regarding the loss of virulency on different media as compared to blood agar are likewise confirmed. The additional conclusion we can draw is that whooping cough bacillus is composed of a single strain species which tends to revert to a resting or nondisease-producing state when artificially cultivated and which under circumstances may revert to a disease-producing state.

From observations based upon the complement-fixing antibodies in the rabbit after injection of the antigens, Miller[4] recently stated that whooping cough endotoxins are nearly as antigenically potent as freshly isolated organisms.

Frawley[5] complains of the reactions obtained with vaccines which contain not only endotoxin, but the killed bacteria as well, and feels that his antigen is of prophylactic benefit.

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DISCUSSION

DR. JAMES W. ROSENFELD (PORTLAND, ORE.).—Probably most of the men here have had the experience of whooping cough running its full course and stopping completely. Dr. Sauer made the remark that from three to four weeks after the cough started the patient was noncontagious. We have all had, too, the experience of whooping cough recurring several weeks or months after the initial infection. I was wondering if there has been any bacteriologic examination of that recurrence.

DR. SAUER.—We have done some work on that. The plates were always negative. Sometimes a year or two later the child goes in swimming, contracts a cold, and thinks it is a fresh attack of whooping cough; but the plates are always negative.

CHAIRMAN TOOMEY.—Whooping cough as a cause of asthma in children is not stressed nearly as much as it should be. I do not know whether or not they have the organisms in the nasal passages.

DR. FREDERICK B. MINER (FLINT, MICH.).—I know of one patient who had asthma very severely before having whooping cough, and the asthma was cleared up by the whooping cough entirely.

CHAIRMAN TOOMEY.—That is also temporarily true of measles, but the asthma usually recurs.

DR. HUENEKENS.—I was interested in what you said about the smooth and rough types of bacteria. In German literature the fresh types are considered the more valuable, and they belong to the smooth type.

CHAIRMAN TOOMEY.—I am not familiar with the German work referred to.

DR. BRUCE.—I would like to ask about the kind of blood used in the media. I understood Dr. Sauer said a while ago any kind of blood could be used, and then did you not just say horse's blood was not very satisfactory?

CHAIRMAN TOOMEY.—We do not think horse's blood is very satisfactory since it will agglutinate the organisms. Dr. Sauer has stated any human blood may be utilized. We used placental blood.

The experience of Godfrey in Boston is interesting. When Madsen came here and delivered his Harvard lecture some years ago, the men in Boston became enthusiastic about the use of pertussis vaccine, and they immediately started its use. Godfrey used it. I wish to be corrected if my statements are inaccurate because I do not remember the facts exactly—but as I remember it, he used freshly isolated material, and he came to the conclusion that such vaccine did not prevent the disease in exposures, but he thought that in 60 per cent of the cases it might have modified its course when it did occur.

DR. SAUER.—I do not know about Godfrey's work.

Madsen's work shows that with a dose as small as 2.2 c.c. of the vaccine you get a complement fixation, which is almost as high as with the disease, but it

does not stay there. Martin Christensen, working in the same laboratory, and Ludekens' wonderful work show the same result. They plotted the curve to show the development of complement fixation. If they had only used about three times as much vaccine they could have kept the fixation titer high and the curve instead of dipping down, would have remained straight.

We had to isolate our own organism when we used the cough-plate method. We noticed that hemolysis was present in some and not others and thought the larger the zone the more virulent the organism. Consequently we arbitrarily picked out those colonies and determined that was true. Since the organism grows only in humans, we thought human blood would be the best for cultures. Madsen uses horse's blood; over there the organism will grow on horse's blood. The New York City Board of Health uses horse's blood, and we used to buy our vaccine from that department many years ago. It was very weak. All we did was to try to duplicate the work that has been done for typhoid. You must have the courage to give a full dose. We have never deviated from the first, using the vaccine with the idea of immunizing and preventing the disease. We have never changed the technic, strength, or the dose. These reactions are not so bad.

DR. SCHWARZ.—I have one patient, about a year old now, who was given the vaccine when about a month old. What is the particular reason for giving it after the period of greatest danger was past? The highest mortality from whooping cough is in the younger individuals. In the South we do not worry about whooping cough after two years of age. It is distressing for the family, but the children get along very well. Recently you recommended giving the vaccine at about six months of age. As to the age limit, what about six months or a year?

DR. SAUER.—I think the best age is eight months, after the child is over the period of feeding problems. Not many babies get whooping cough under a year of age. At The Cradle, I had an opportunity to see whether a baby so young can be immunized. You cannot immunize an infant that young against diphtheria. Giving the vaccine has never affected their weight curve, and they practically never have a fever. Older children sometimes have a temperature of 102° F., but the fever is gone the next day. The reaction is local, I think. I like to see reactions.

DR. GENGENBACH.—Have any of those Cradle babies been exposed to whooping cough? How old is the oldest one now?

DR. SAUER.—The babies are not more than two months old. One baby went out of town after receiving only two injections and contracted whooping cough. A few other babies have developed whooping cough. A physician in Baltimore inoculated his two children last summer, and this year they developed whooping cough. I received a letter from a New Jersey physician who inoculated a child who developed mild whooping cough six or seven months later. Those are the only cases I know of in which the child got whooping cough, and these cases were not severe. We are not giving those babies 8 c.c. We cut it down to 6 c.c., not on account of the reactions, but because we did not have enough material to use, and they are so small I thought six would be enough. If 6 c.c. will protect 8 c.c. will.

CHAIRMAN TOOMEY.—Gentlemen, I take great pleasure in introducing Dr. Price, professor of pediatrics, University of Pittsburgh, who will introduce the topic, "The Treatment of Pertussis."

The Treatment of Pertussis

H. T. Price, M.D., Pittsburgh, Pa.

Dr. Osler is alleged to have said that the treatment of pertussis is six weeks and a good, big bottle of paregoric. At present, there is no generally accepted specific medication and the multiplicity of remedies in use merely emphasizes this statement. Being an endemic, as well as an epidemic disease, pertussis has not received the proper attention which it most certainly deserves as shown by its high mortality rate. Being with us always, it may be classed as a necessary evil, and being a self-limited disease it has been looked upon as one of those diseases which will run its course provided the patient does not succumb from complications.

The course of the disease can be modified in many cases by the judicious use of drugs, and there are several which seem to be so far superior in effect that they are most frequently prescribed. The bromides have always been of value and may be prescribed with safety, considering, however, their cumulative effect and the tendency to cause eruptions on the skin surface. Belladonna, in some one of its forms, is a very valuable drug in many cases, but here, also, one must be alert to observe untoward symptoms. The use of atropine, especially in the infant, over a prolonged period, is inadvisable and often contraindicated. The use of coal tar products has been advised for many years and antipyrine is preferred in this group on account of its solubility.

With this group of drugs, a very acceptable prescription can be compounded and one may be assured of relief of symptoms in a satisfactory number of cases. For a child of two years:

Sodii bromidi	1.950	℥ss
Antipyrine	1.040	gr.xvi
Tr. Belladonna	1.950	f℥ss
Elixir simplicis	30.0	f℥i
Aq. destil., q.s., ad.	60.0	f℥ii

M.S. A teaspoonful every two to four hours.

Quinine is a drug that is highly recommended, but on account of its unpleasant taste it is difficult to prepare it in a palatable form for young children and infants. Phenobarbital and new sedative remedies are quite popular at the present time and the following treatment has been suggested by one of our colleagues:

Amytal	0.097	gr.iss
Amidopyrine	0.195	gr.iii

Give this dose every three to six hours as needed, to a child of six years and a graded reduction to a younger child.

Some form of opium is usually added to most of the accepted remedies and is a very valuable drug, but for some reason it does not measure up to expectations in its use for this particular disease. Perhaps, prejudice of the laity curtails its use if the parent learns of its administration.

X-ray treatment has been highly extolled and for a time was used quite extensively, but it is my belief that its value has not measured up to the expectations of enthusiastic advocates and that real harm may result from its use. This agent has a real danger in its use and even expert radiologists do not understand its full therapeutic action, especially in infants.

Of the remedies suggested in recent years, ether is by far the most valuable and effective. At first it was used subcutaneously or intramuscularly, but this method

of treatment was not ideal, and at present the drug is used chiefly by injection into the bowel with oil as a vehicle.

Ether	15.0 f℥ss
Olive oil, q.s., ad.	90.0 f℥iii

For a child of two years, as much as one ounce of the above mixture may be injected into the bowel at proper intervals to relieve symptoms and may be given as often as every third hour. Usually, ½ ounce three or four times daily is effective, but the necessary precaution must be taken to have the fluid retained by local pressure if there is a tendency to expel it.

Almost every known medicated vapor has been suggested as a specific for pertussis. Many of these preparations seem to have some influence in individual cases, but none has been successful enough to receive outstanding recognition. It must be emphasized with the use of such preparations that one must be extremely careful to avoid further irritation of the mucous membranes, and as enthusiastic attendants and overwrought parents usually have no knowledge of this fact, harm is frequently done.

In my student days, there was a tradition that coal-gas-laden air was a specific for whooping cough, and it was the custom of the people to take their affected children to the gas works and spend the day in this vicinity. The idea was excellent but the belief false. These youngsters were removed to fresh air in the open from close stuffy rooms; they were kept quiet and in this district they were much cooler than at home. Fresh air and peace were the beneficial attainments. Sea air is believed, in some localities, to be specific in the treatment of pertussis and again the benefit is derived from the fresh air rather than any specific quality.

Local applications are very popular with the layman and are extensively used. Here, too, enthusiasm may do harm by using preparations that are irritating and by hampering an already embarrassed respiration with weighty poultices, plasters, and bandages. A mechanical device that affords great relief and comfort to the infant is the Kilmer Belt and it is surprising that it is not more generally recommended. Experience seems to indicate that the child is less exhausted after a severe paroxysm of coughing when using this belt than before its application. It is simple in construction, inexpensive and does give a definite support to the abdomen during the paroxysm.

In uncomplicated cases the greatest danger is from the mechanical action of the paroxysm, and in the complicated ones these dangers are greatly multiplied. The first great danger is from suffocation. If the child has a severe paroxysm of coughing and cannot get his breath easily, the spasm frequently causes a comatose state which ends in complete relaxation of the child with a gradual restoration of normal functions later. This happy termination does not always result, and in bad cases a second paroxysm may begin before the infant has fully recovered from the effects of the previous attack, and conditions become serious. The strain on the child from these attacks is so great that one is surprised when more serious harm has not resulted. Hemorrhages are frequent, and often the damage is not immediately apparent. On the other hand, this damage is so extensive and irreparable that the child may succumb.

Theoretically, pertussis convalescent serum should be of considerable value. The preparation of this serum is, at present, expensive, and there has not been sufficient corroborative data available to warrant its general use.

Vaccines have been recommended for the treatment of pertussis and have been used extensively. At the present time, the consensus of opinion is that they are of no practical value, and their use is discouraged. The brightest prospect for relief from this terrific disease is through prevention. Our colleague, Dr. Sauer, has pro-

posed a method of immunization which offers the greatest hope of prevention, and every effort should be exerted by the medical profession to perfect this procedure so that it may have universal application.

Until the physician can give the public a specific curative measure or a definite prophylactic procedure, this dreadful disease will continue to cause the highest number of deaths among the diseases of childhood. The general public will grasp at anything which seems to offer some relief, and in spite of valuable remedies under our control, many babies will continue to die.

CHAIRMAN TOOMEY.—The topic is open for discussion.

DR. ELWOOD W. STITZEL (ALTOONA, PA.).—I would like to ask whether Dr. Price feels that the use of mixed vaccines lessens the number of complications. I have felt that it does. If everyone who is using Dr. Sauer's vaccine as a preventive measure would keep a careful record and supply Dr. Sauer or the Secretary of the Academy with that data, it seems to me a great deal of valuable information might be obtained because there would be a large number of cases which would undoubtedly give a cross-section of the results obtained throughout the country. The more cases we have the more valuable the findings will be.

DR. ROSENFELD.—One therapeutic measure which I think has a great deal of value, if properly administered, is the use of chloroform. Dr. Price did not mention it. When an adult with whooping cough has that terrible distressing feeling of suffocation I think a great deal of benefit is derived from the relief of the intensity of the paroxysms. I have even used it, intelligently administered, in children who go into the comatose stage or whose paroxysms may result in a general convulsive seizure.

As far as initial therapy is concerned, I have followed a routine once established by Dr. Schick, that is, to put a child to bed for the first two weeks of whooping cough to lessen the intensity of the paroxysms and to prevent secondary infections from developing.

CHAIRMAN TOOMEY.—Tell us just exactly how you give the chloroform.

DR. ROSENFELD.—Just enough chloroform is administered with air coming in under the inhaler to lessen the intensity or even abort the paroxysm as it develops, but never to the stage of anesthesia. Another drug, codeine, may be used in very large amounts in children with no distressing results.

One other point of importance in whooping cough is the variable virulence of the epidemic. We have now a very widespread epidemic in the Pacific Northwest, but a large proportion of the children have their coughs subside at the end of the fourth week and may never have developed real whoop paroxysms. We have the paroxysms without the whoop, and our vaccine measures, both for treatment and prophylaxis, have not given us much information on account of the mildness of that epidemic.

DR. COWIE.—I would like to change Dr. Osler's remark and, instead of saying paregoric, put in a bottle of belladonna. I have used belladonna for many, many years. There is really no danger from its use, and I think the lack of success is because physicians are afraid to use it. The belladonna passage must be pushed to the point of bringing about a physiologic reaction, and then continuing just short of that, as you do in treating pyloric stenosis. It is very interesting to see that the whooping child is resistant to belladonna. I have found it a very useful remedy.

DR. ELMER G. HORTON (COLUMBUS, OHIO).—I should like to hear Dr. Price discuss postural drainage which we have found highly desirable.

DR. H. L. MOORE (DALLAS, TEXAS).—I have recently had a two-year-old child with a rather severe attack of whooping cough. The mother was to be confined in pregnancy within six weeks. At the time of her confinement she was sent to the hospital, and the child with the whooping cough was sent to the grandmother in an adjoining city. Two weeks after birth, the new baby was brought home. During the period at the hospital it developed a terrific spasmodic colic, necessitating a quarter of a grain of sodium phenobarbital every three hours to keep it comfortable. This child had been on this dosage for something like eight or ten days. After it was brought home, I tried to reduce the dose to an eighth of a grain; but when I did, the spasmodic colic continued; consequently, I continued with the quarter of a grain. At the end of three weeks the child developed whooping cough, having about six spasmodic attacks a day, but of the mildest I have ever seen, though with a typical spasmodic whooping cough. I wondered if that three weeks' treatment with the quarter of a grain of sodium phenobarbital in solution had anything to do with it. The child went through it without any trouble.

DR. GREENEBAUM.—Dr. Price has hinted at the use of a convalescent serum. I should like to ask Dr. Toomey to tell us if there is any theoretical objection to that and what type of serum should be used—whether from a person who has been immunized with vaccine or from a person who has had the disease—and how long before? That offers great hope, particularly in little babies who get whooping cough.

DR. STANLEY D. GIFFEN (TOLEDO, OHIO).—I think the mention of the drug amidopyrine ought not to be made without mention of the danger of agranulocytopenia.

CHAIRMAN TOOMEY.—We have obtained and used convalescent whooping cough serum. I cannot say whether it is any good, but most of the serum was used down in Dr. Price's neighborhood, in Pittsburgh. The physicians around Cleveland use it quite a bit, too. Most of them use it in young babies or where they fear the effect of the disease or an existing complication. They write back enthusiastic remarks about it. We usually give 10 c.c. of serum intramuscularly. As far as taking the serum from patients who are immunized with Dr. Sauer's vaccine or any vaccine, I do not see why their serum would be any different than those you get after vaccinating against smallpox. You cannot determine virus in vaccinated patients, though you can in patients who have had a severe infection.

DR. PRICE.—This disease is so terrific in the child under one year that I think any treatment that offers any hope is valuable. There is no doubt the men here have seen many patients die with all the help they have been able to give. I use the vaccine in the routine way, especially in babies, and I usually use a mixed vaccine with the hope of preventing complications. That is empirical, but nevertheless, as I say, I am grasping at a straw because I do not like to see these youngsters die.

Chloroform has been used very extensively, but for some reason or other it has fallen into disuse. I think it is a valuable remedy, but we do not know much about it. It may be a valuable drug in the hands of those who know how to use it.

Dr. Cowie's reference to belladonna is important, and my belief is to give any drug in doses up to its physiologic effect. I believe there is no use in giving any medication at all unless it is given to its physiologic effect, bearing in mind individual idiosyncrasies. Postural drainage is of value in some cases, but it does not give the result we would expect. Phenobarbital and the newer remedies were men-

tioned because they are so widely advertised. I do not use them extensively because I stick a little bit close to the older remedies.

Convalescent serum, as Dr. Toomey has told you, is an experiment. After the serum is given, the child may not develop whooping cough. We do not know whether to blame it on the convalescent serum or not, but it is a thing worth while developing.

DR. McGEE.—In reference to the mortality—I have had one death in eight years. That was in a premature baby with a 150,000 blood count, bronchopneumonia, and diarrhea. He had vaccines and everything you could think of; yet he died.

In reference to the drugs—about seven years ago I began comparing the common antispasmodics, belladonna, phenobarbital, bromides, about fifteen or twenty of them with no treatment, and the same number with phenohydrochloride, with ether by rectum alone, with vaccines alone, representing 250 cases all told, the majority being in the ether group. There was approximately a 30 per cent very favorable improvement with the vaccine and the same with phenohydrochloride. The best treatment by far was rectal ether. It is very easily available and costs practically nothing. The mother can give the treatment after she is shown once.

I use a stronger solution than Dr. Price recommended. I started with a strength of 25 per cent but did not get results until I used a dram of 50 per cent solution per year of age twice daily, finding it unnecessary to give it more often than that when it was retained. There is no irritation of the rectum, no damage to the heart, lungs, or kidneys.

These children over a year of age seem to be improved after about the third night unless the weather is very damp, and from about the tenth to the fourteenth day they reach the stage of decline. This is true in about 75 per cent of the cases. A Japanese reporting some 106 cases reported 84.59 per cent improved, a very close similarity.

It is attention to details that will give results with ether treatments. The details I have in mind are elevating the hips with a couple of pillows and lying on the stomach. The ether is best given by a catheter placed six or eight inches high in the rectum to expel the air before the ether is given and to let it flow in by gravity. Anything that gets the mind off the rectum and the strain on the abdominal muscles is good, such as blowing bubbles, sucking the thumb, etc. It can be done if the child is old enough to cooperate. Once in a while a child simply cannot retain the ether. In those cases it seems to do just as well if the dose is divided in half and the treatment given once a day,

I started out to be a vaccine enthusiast and, if 30 per cent of the cases improved, I was tickled to death. The earlier whooping cough is diagnosed by the cough plate, the blood count, or by any other means, and the treatment with ether is started, the better the results, regardless of age.

In reference to using a belt or opiates—I have always had a theory that their use was physiologically incompatible. Mothers whose children have had vaccines before have told me that they believe ether gives by far the best results. I do not dread whooping cough any more.

CHAIRMAN TOOMEY.—I just wish to comment on Dr. McGee's experience so far as mortality is concerned. He had 400 cases, and none of those children died. We have had 1,112 cases the last three or four years and 166 patients have died. The population of Mississippi is 900,000 whites and 1,100,000 colored. In the mortality statistics for 1929 (U. S. Department of Commerce) Mississippi had a mortality rate of 10.6 per 100,000.

DR. McGEE.—Virginia reported 354 year before last.

CHAIRMAN TOOMEY.—I think instead of using Dr. Sauer's vaccine we should move to Virginia. In 1929, quoting mortality records of the Department of Commerce, the mortality rate of Virginia was 11.7 per 100,000, and the deaths from the disease among the negroes was 23.4 per 100,000, the highest death rate for colored people in any state of the Union.

DR. GILBERT J. LEVY (MEMPHIS, TENN.).—It may be that we live so close to Mississippi that we have such a very high mortality. My experience for fifteen years in a contagious hospital verifies what Dr. Toomey says. We have 100,000 negroes in our community and our mortality has been very high. We have been very unsuccessful in the many methods of treatment employed, particularly in the use of ether and olive oil. That particular preparation has been a rank failure. We have used as much as two drams of ether and an equal amount of olive oil every three hours, with competent nurses in charge who have been in our institution many years. We have discarded such treatment long ago.

I should like to recite to you some of the few remedies suggested by the parents of some of these negro children: buttons, rabbits' feet, asafetida, strings, salt and pepper bags.

It has always been my belief that what the patient needs is rest, especially in whooping cough accompanied by respiratory complications. Any infant with a respiratory rate of 120 needs opium in some form. I think opium is the ideal drug, whether you use paregoric, codeine, or any other; next to that, perhaps, comes atropine in the form of tincture of belladonna.

CHAIRMAN TOOMEY.—Dr. Price, have you anything to add?

DR. PRICE.—Nothing except on the mortality question. I'd like Dr. McGee to take care of my whooping cough cases.

CHAIRMAN TOOMEY.—I wish to introduce Dr. Cowie, professor of pediatrics, University of Michigan, who will introduce the topic, "The Complications of Whooping Cough."

The Complications of Whooping Cough

D. Murray Cowie, M.D., Ann Arbor, Mich.

The 1929 United States infant mortality statistics state that about 10,000 patients die each year in the United States from whooping cough. Nearly all of these deaths occur in infants under one year of age. It is the complications of whooping cough that are responsible for this large number of deaths. In the order of their importance as death dealers, they may be listed as pulmonary, hemorrhagic, and central nervous system complications.

Pulmonary.—The most common and the most important complications of whooping cough are those of the respiratory system. Initiated by an acute catarrhal inflammation of the upper respiratory tract, the disease process descends causing a bronchitis, a peribronchitis, and a peribronchiolitis. All seems to go well until the paroxysmal stage of the disease is reached. It is now quite generally believed that the whooping cough germ or virus, if that ultimately proves to be the specific cause, prepares the lung for, or makes it susceptible to, a mixed infection. While *B. pertussis* undoubtedly plays an important rôle in the development of pneumonia, this complication is particularly the result of the action of a variety of microorganisms as you have already heard.

Small granular foci of pneumonia are described[1] as particularly likely to occur in the early part of the paroxysmal stage. These are in fact miniature nodules

of peribronchiolitis which, by some, are thought to occur in a large percentage of children with whooping cough, and it is thought that from these foci pneumonia ultimately develops either as the lobular or the bronchopneumonic type. It is believed that a more or less chronic infection of the lung tissue has been initiated from the hilar glands, which infection in the course of a few weeks extends along the lymphatics to the interstitial tissue where it sets up an inflammation. So frequently has this progressive involvement been noticed that it is becoming common to hear the term "pertussis lung." The interstitial character of the pneumonia of whooping cough is thought by some to lend support to the belief that it is a virus disease because it is similar to the type of lung involvement that has been found common in these diseases. This, of course, is only an analogy.

The three-cornered wedge-shaped shadows seen in x-rays of the whooping cough lung are thought by some to be characteristic of the disease, but Göttch, who has made a special study of them, finds they are not peculiar to whooping cough. These shadows radiate from the hilum downward toward the diaphragm, and in marked cases they are well outlined and are thought to be due to the infiltration or inflammation of the interstitial tissue. Such shadows suggest tuberculous involvement. Wildtgrube observed it in only three of 107 patients who had a negative tuberculin reaction. Of 360 patients carefully studied by him in 1930, thirty-five died, the majority from pneumonia.

You know very well the clinical manifestations of pneumonia when it complicates whooping cough. There is one point that I feel should be stressed to parents or guardians when we finally tell them that their child has whooping cough. When we inform them concerning the high susceptibility of children with whooping cough to pneumonia and of the seriousness of this complication, we should warn them to regard the disappearance of the paroxysmal cough, when associated with the development of fever, as an indication that this complication is probably beginning and that special medical supervision will be necessary. It is quite well known that when pneumonia begins the paroxysmal cough stops; when the patient recovers from pneumonia, the paroxysmal cough may be resumed. Mikulowski[2] points out that whooping cough is the chief scourge of infancy, that it is comparable to tuberculosis in the adult, and that relapses may occur over periods of months.

Tuberculosis.—There are two often-expressed beliefs concerning whooping cough and tuberculosis: one, that whooping cough is frequently followed by tuberculosis, that it activates a previous tuberculosis focus; the other, that there is little to fear from whooping cough developing in a tuberculin positive child. Gabriel[3] gives an interesting report of his studies on 1,995 cases of whooping cough in children in Vienna. The greatest number of these patients were one and two years old. From this number of cases he records the results of 359 autopsies: 41 per cent of these patients were one year old; 22 per cent, two years old; 5 per cent, three years; 1.5 per cent, four; and 1.6 per cent, five years old. Tuberculosis was found in thirty-nine, or 10.9 per cent. He believes that the only criterion of the effect of whooping cough on a previously tuberculous child as recognized by a positive tuberculin test is the follow-up method. He observed 491 cases for five years. By the end of two years nineteen children had died, four from tuberculous meningitis and one from tuberculosis of the lungs (15 per cent). Of the remaining fourteen, eleven died from nontuberculous pulmonary complications. Seven of the group died later than two years after whooping cough, two with tuberculous meningitis, two with pneumonia, one by accident, one with diphtheria, and the cause of death in the other was not determined.

Another series of interest is that studied by Choffé[4] in a large children's home in Paris. He compares whooping cough and measles with regard to their effect on

predisposition to tuberculosis. One hundred thirty-seven of these children had measles; 99, whooping cough. One-third of the measles patients had tuberculous ancestors, six of whom had open tuberculosis. Forty per cent of them had tracheobronchial adenopathy of sufficient degree to justify suspicion of tuberculosis in one-third of them, but only two of these children developed tuberculosis. In five of the ninety-nine whooping cough patients, active tuberculous lesions had at one time been demonstrated. Only one of these developed tuberculosis, and it was questioned whether whooping cough was responsible. In the other patients no untoward sequelae developed.

Feyrter[3] concluded from a study of the series recorded by Gabriel that there was no basis to be found for the belief that whooping cough exerts an unfavorable influence on a previously tuberculous child.

While these opinions and facts are of importance there are still many who believe whooping cough exerts an unfavorable influence on a previously tuberculous or tuberculin-positive child. So careful an observer and pathologist as Osler believed that "in a considerable proportion of the cases (pneumonia) the process is tuberculous." I record here an instance of tuberculous meningitis initiated by whooping cough.

Purulent Bronchitis characterized by high temperature and purulent sputum may develop and be associated with bronchiectatic dilatations. Dunken[5] describes similar radiating shadows in the x-ray as those described under pneumonia. It would seem that bronchiectasis would occur as a complication of whooping cough more often than it does. It occurred once in my series. Enlargement of the bronchial glands often becomes a complicating factor.

Generalized Emphysema.—Unger[6] reports an autopsy on a ten-month-old infant with whooping cough with well-developed bronchopneumonia. There was supraclavicular cutaneous emphysema, bulbous emphysema of both lungs, and interstitial emphysema in the hilar and mediastinal connective tissue.

Osler[7] records a case with pneumothorax in which the "rupture occurred, evidently near the root of the lung, and the air passed along the trachea and reached the neck, a condition which has been known to become general."

Pleural effusion, atelectases, lobar pneumonia, associated measles, chicken pox, and mumps are complications recorded in my appended series.

Hemorrhages.—The hemorrhagic complications of whooping cough are well known and are not uncommon. Chief interest attaches itself to the mechanism of their production. For over twenty-five years two theories have been supported: venous engorgement or increased intravenous pressure from the mechanical effects of the paroxysmal coughing and induced hemorrhagic diathesis from the effect of the toxin on the blood vessels.

The question arises, is it possible for the mechanical venous congestion of the degree induced by the paroxysms to be sufficient to cause hemorrhages into the skin, the mucous membranes, the meninges, and the brain of a normal person? In whooping cough the mechanical factor producing the increased intravenous pressure often is associated with agitation of the body, i.e., clonic convulsions. This adds a factor to the mere production of stases as, for example, by a tourniquet. On the other hand, in grand mal attacks of epilepsy—where marked congestion is associated and clonic convulsions equally, if not more severe—these types of hemorrhage are certainly much less common. In certain diseases in which hemorrhages occur unassociated with agitated or convulsive states, the tying of a tourniquet about the arm results in petechial or purpuric hemorrhages—for example, the purpuras, scarlet fever, scurvy, the severe anemias, and leucemia. This procedure in a normal person produces no hemorrhage.

If a certain degree of negative pressure, gauged by a mercury manometer, is exerted and maintained over a circumscribed area of skin with a cupping glass, the normal skin will withstand this pressure for much longer periods of time than will that of a patient afflicted with purpura, hemophilia, familial bleeding, scarlet fever, etc. This, I think, indicates that some change has taken place either in the vessel wall in the diseased state, making it more permeable to the contents of the vessels, or in the blood itself, making it more readily diffusible through the membrane. If we induce stases, cyanosis, in a kidney by orthostatic action, albumin passes through the capsule in a comparatively short time; but rarely is blood seen, and then only microscopically. Here we have a combined mechanical and chemical force acting on the membrane, making it more permeable. These facts lead one to consider carefully the probability that there are other than mechanical factors at work in the production of the hemorrhages of whooping cough. Mikulowski expresses the belief that hyperemia, edema of the brain and meninges, and venous thrombosis are the result of the whooping cough toxin and of the infectious influence of the pertussis virus and that the changes induced are closely connected with the pulmonary changes arising from a center of infection in the lungs. Here, with the exception of a few refinements he gives the view expressed many years ago. Direct observations on the effect of intravenous pertussis toxin may in time answer this question. In fact, Hayakawa[8] in 1929 determined the M.L.D. of *B. pertussis* toxin on rabbits and claims that one-twentieth or one-thirtieth of an M.L.D. injected intravenously into rabbits produces characteristic vascular and interstitial changes in the lungs. He believes the endotoxin might easily affect the vessel walls and be responsible for the various types of hemorrhage seen in whooping cough. Neurath[9] (1908) was of the opinion that a lesion in the vessel wall plays a greater rôle in the pathogenesis than the increased intravenous pressure.

Cerebral hemorrhages may bring about any of the types of cerebral palsy including bulbar paralysis. Blindness due to hemorrhage into the anterior chamber of the eye sometimes occurs. It usually clears up completely, leaving unimpaired vision.

Central Nervous System.—It is unfortunate that there are so comparatively few complete pathologic studies of the central nervous system of patients dying from conditions initiated by whooping cough. It might well be that such studies, even in the absence of clinical manifestations of central nervous system involvement, would be helpful in providing a true basis for the general belief that nonfatal encephalitis frequently occurs or that some of the syndromes observed may in reality be only encephalopathies.

Encephalitis.—Encephalitis does not always kill. In fact there are many cases of complications in the course of the infectious diseases, measles, influenza, vaccinia, and mumps; these patients present the undeniable findings of encephalitis, many of them recovering without prominent focal changes and others with transient or permanent palsies or functional impairments. There are still others that come to autopsy, proving that the clinical contention was correct.

In a number of the autopsies on cases of pertussis encephalitis, associated cerebral hemorrhage and meningitis have been observed. Askin and Zimmerman[10] cite a case reported by Hada in 1913 with encephalitic changes in parts of the brain adjacent to the sulci as a complication of whooping cough. They state that until then no case of an isolated cerebral hemorrhage in whooping cough had been reported which was not associated with hemorrhagic encephalitis or meningitis. Husler and Spatz[10] describe the changes in the cerebral cortex in pertussis encephalitis as consisting of a loss of the staining properties of the cells with obliteration of the Nissl picture, the nucleus alone remaining, and the presence of

certain vacuoles, particularly in the hippocampus major area, which they considered to be the site of completely degenerated ganglion cells. They point out that these are not specific changes because they occur in other cerebral inflammatory processes. A confirmation of these findings is contained in the report of a case of encephalitis complicating whooping cough by Jochims.[10] No evidence of hemorrhage, edema, exudate, or necroses was found but he regarded the changes as characteristic of inflammation.

Askin and Zimmerman's pathologic report of a case of whooping cough with encephalitis as a complication in an infant, four months old, reviews (1929) the subject to date and furnishes us with an excellent protocol of the pathologic findings. This infant was clinically considered to be suggestive of encephalitis. In brief, they found at autopsy acute diffuse encephalitis, subarachnoid hemorrhage, diffuse scattered focal areas or collections of small deeply staining mononuclear cells, some of which were circular, giving the appearance of the cross-section perivascular infiltration seen in epidemic polioencephalitis but which on close examination proved not to be perivascular. No typical perivascular collar could anywhere be found. The meninges were entirely free. We have shown in our pathologic studies of epidemic polioencephalitis in man and monkey an identical resemblance to the picture produced by rabies and Borna's disease of horses. These diseases are believed to be due to a filtrable virus. In whooping cough encephalitis, the picture as recorded by Askin and Zimmerman at first glance suggests but differs from that of the virus diseases cited.

Mikulowski[11] believes that the lesions in the central nervous system and in the vascular system are due to a specific virus toxin and that a rôle is played by a hemorrhagic diathesis which produces dysfunction of the liver which has been injured by the toxin.

Of the other central nervous system complications, tetany should be mentioned. Theories advanced for its occurrence are that it may be due to the spasmophile diatheses, or to a loss of HCl from persistent vomiting. In cases observed, there has been no change in the blood calcium. Latent, rather than manifest, symptoms are described. Neurath lists flaccid spinal paralyses, polyneuritis, and psychic disturbances, such as transient hallucinations, as occasional complications and Friedreich's ataxia, Landry's ascending paralysis, pseudotabes and idiocy as sequelae. In a case of whooping cough in my practice, a lad three years old, whose speech developed normally, lost his ability to talk near the end of the disease and has not regained it after two years. Careful tests show that he now possesses ability to produce every sound normal to English speech. He is beginning to make efforts to talk. Cerebral abscess and acute hydrocephalus as complications were recorded.

For the complications mentioned, there is no specific treatment, unless in the cases of encephalitis intravenous convalescent whooping cough serum or blood transfusions may be found to be beneficial, particularly if instituted early.

Cardiac and Circulatory Complications.—These complications are stressed by many writers. The terrific strain induced by the paroxysmal coughing brings about engorgement of the right heart and pulmonary congestion. Cardiac dilatation is not uncommon, and in the enfeebled child rupture of the heart has occurred. Myocardial sequelae rather than valvular would seem to be the rule. While Osler offers no proof, he felt that "possibly some cases of severe valvular disease in children who have had neither rheumatism nor scarlet fever may be attributed to the terrible heart strain during a prolonged attack." It is not at all improbable that, should we follow up our whooping cough cases more carefully, we would find evidence of cardiac complications attributable to it.

Otitis media is the second most common complication in my series. The well-known ulcer of the frenum of the tongue, prolapse of the rectum, hernias, and the case of gangrenous appendix here recorded should also be mentioned.

As an illustration of how the complications run, I will give you an analysis of the last 120 consecutive cases on my service at the University Hospital.

Bronchopneumonia	10	
Bronchopneumonia and associated measles	1	
Bronchopneumonia and subarachnoid hemorrhage	1	
Bronchopneumonia and bilateral otitis media	1	
Bronchiectases	1	
Atelectasis—right lower lobe, posterior	1	
Lobar pneumonia	1	
Pleural effusion	1	17—46%
Associated measles	2	
Associated chickenpox	5	
Associated mumps with encephalitis	1	
Otitis media, unilateral	3	
Otitis media, bilateral	5	
Otitis media and chickenpox	1	
Tuberculous meningitis	1	
Inguinal hernia	1	
Acute gangrenous appendix	1	6th week
	37	

Of the fourteen pneumonia complications, two occurred during the first week, five the second, one the third and six the fourth week. Of the nine otitis media complications, two occurred the first week; four, the third; two, the fourth; and one, the fifth week. The encephalitis complication occurred during the first week of whooping cough and was followed by mumps. The spinal fluid showed 300 cells, mostly lymphocytes, and the pressure was increased. There were marked symptoms of irritation. The complication was first thought to be tuberculous meningitis but the fluid gradually cleared, and complete recovery resulted. The tuberculous meningitis complication developed in a child with Pott's disease during the fourth week of whooping cough. The findings were all characteristic. This may be considered an illustration in favor of the idea that whooping cough exerts an unfavorable influence on a previous tuberculous process. The patient died, but no autopsy could be obtained. The complication of pleural effusion occurred during the first week. These statistics show the great tendency to lung complications. They comprised 46 per cent of all the complications.

When we view whooping cough in the light of the frequency and seriousness of its complications, we are compelled to regard it as one of the greatest if not the greatest menace of early life. Made possible by the reporting and isolation of the disease during recent years, a careful study by the Metropolitan Life Insurance Company shows that there has been a steady decline in the death rate since 1911 when the rate among their group of children was ninety per thousand. In 1930 it had dropped to twenty per thousand, the highest incidence being between three and six years.

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DISCUSSION

CHAIRMAN TOOMEY.—Are there any questions?

DR. COWIE.—I'd like to point out that this is an unusual series of cases that developed under rather excellent conditions. The large majority of these children developed whooping cough under our eye in spite of all the excellent care we could give them. Notice the high percentage of complications, 37.25 per cent.

CHAIRMAN TOOMEY.—If there is no further business to come before the meeting, we will declare the meeting adjourned.

REPORT OF THE COMMITTEE ON HOSPITALS AND DISPENSARIES

(CONTINUED)

DIET KITCHEN, PHYSIOTHERAPY, X-RAY, LABORATORIES, AND MISCELLANEOUS

Twenty-eight hospitals indicate that they have facilities for physiotherapy. One has limited facilities; one has no facilities and four did not reply.

Among the twenty-eght hospitals equipped for physiotherapy twenty-four maintain a definite separate department for that work, and fifteen of these have full-time directors. Twenty-three have full-time technicians. Usually there is one technician but two hospitals have six; three have three; and five have two. Seven report part-time as well as full-time technicians. Four report only part-time technicians. The most commonly used forms of physiotherapy are dry heat, moist heat, massage, ultraviolet, diathermy, and electricity. Table I indicates how frequently all forms are available and whether they are available at the bedside.

Several institutions have swimming tanks and roof solariums for sun treatments.

TABLE I

	FACILITIES FOR	AT BEDSIDE
Dry heat	29	29
Moist heat	29	28
Massage	28	28
Ultraviolet	30	28
Diathermy	18	17
Electricity	22	18

DIET KITCHEN

Thirty-four hospitals have trained dietitians in charge of the diet kitchen; one did not reply. In each instance, according to the qualifications stated in the questionnaire, the respective dietitians seem to have competent training for their work. Many of them are college graduates and, of course, have had special training in dietetics.

In thirty-four hospitals the dietitian is in entire charge of the menus. In one she had charge only of special diets; one did not reply.

In six instances "standard" special diets are in charge of the dietitian alone. In eight instances they are in charge only of the physician and in twenty, physicians and dietitians cooperate to supervise the diets. One did not reply. Seven hospitals report that they have one dietitian who gives her entire time to the dispensary. Eight have dietitians who work in both the dispensary and the hospital. In no instance does the dietitian see all new patients in the dispensary, and in only nine instances does she see patients at regular intervals. The dietitian offers practical teaching in the preparation of diets in seventeen instances. This instruction is usually only given to the individual, occasionally to groups and in all instances only to dispensary patients. Instruction is available to the community at large in only one instance.

Miscellaneous

OCCUPATIONAL THERAPY

Twenty hospitals provide facilities for occupational therapy and twelve have full-time workers to supervise the work. Volunteer workers serve in this capacity in all of the twenty hospitals, and where there is a full-time director, they act as assistants. Many of the institutions apparently emphasize this form of activity and have a well-organized staff and excellent equipment. The usual activities are in the form of handicraft and art work of various kinds.

SCHOOLING

Twenty-three hospitals provide schooling for convalescents. In eighteen instances teachers are provided by the public school system. In five instances private teachers are employed by the hospitals. Apparently none employ over three teachers in this capacity; several have only one. In two instances volunteers assist in the work.

RECREATION

Twenty-two hospitals provide play activities for convalescents in the hospital. Six hospitals provide for this activity only in the convalescent homes which are part of their organization. In eleven instances special teachers are assigned to this work. Several institutions have trained playground instructors, others employ "play ladies," nursery maids, "experienced nurses," or volunteer workers. In a few instances this department seems well equipped and well organized; in others the activities are somewhat haphazard.

X-RAY*

Thirty-three hospitals are reported. Most of these seem to be adequately equipped for film and fluoroscopic work for children although four report that they consider their facilities inadequate.

Four report they do not have high speed radiography, i. e., less than 100 ma. (20 stated 1/20 of a second at 50 ma.).

If high speed radiography were supplied, this would be an advantage, especially in chest cases. However, it is only a few years ago that most laboratories had no more than 30-50 ma. available, and that amount can be made to serve fairly well in most cases.

Three report no portable equipment. After all it is comparatively seldom that a child cannot be brought to the x-ray department. Even a fracture bed can usually be rolled into the department for films.

Four do not have twenty-four-hour service available although twenty-three report being able to care for emergencies.

Part-time work is a disadvantage so far as emergency work is concerned. However, emergency work, fractures, foreign bodies, etc., may be rare experiences for these hospitals.

The equipment for therapeutic work varies a good deal among the various hospitals. Eight are equipped for treatment up to 200 KVP (kilovolts peak); one has 160 KVP; three have 140 KVP; one has 135 KVP; one has 130 KVP; two have 120 KVP; three have 100 KVP; eight report less than 100 KVP; four state they have no therapy, and in two therapy is cared for elsewhere. (One writes 220 KVP, but says, "not equipped for deep therapy," therefore, we assume they mean 120 KVP.) Some which are equipped for treatment report very few treatments given.

*We are indebted to Dr. Rose of the Presbyterian Hospital, Chicago, Ill., for aid in preparing this portion of the report.

It would seem that there are few, if any, conditions in children which, in the present state of our knowledge, cannot be treated quite satisfactorily with voltages no higher than 135-140 KVP. Superficial therapy, such as for skin lesions, is of course given with lesser voltages, approximately 90 KVP.

Few hospitals reported internes in the x-ray departments, although there may be more than were reported.

While it is doubtless true that the arrangement of the x-ray department in many instances is such that the interne can be of only a comparatively little assistance, nevertheless the x-ray interneship is one of the very valuable means of teaching the younger men, and a most excellent method of spreading knowledge of the many ways in which x-ray departments may be of help to the clinician in the solving of his problem cases.

TABLE II

HOSPITAL	HOSPITAL X-RAY AND LABORATORY					
	X-RAY ADEQUATE?	CLIN. LAB. ADEQUATE?	BACT. LAB. ADEQUATE?	SEROL. LAB. ADEQUATE?	FACIL. FOR SIMPLE PHOTO.?	ELECTRO-CARDIOGRAPH ADEQUATE?
1.	Yes	Yes	Yes	Yes	Yes	Yes
2.	Yes	Yes	Yes	No	Yes	No
3.	Yes	Yes	Yes	Yes	Yes	Yes
4.	Yes	Yes	Yes	Yes	Yes	Yes
5.	Yes	Yes	Yes	Yes	Yes	Yes
6.	Yes	Yes	Yes	Yes	Yes	Yes
7.	Yes	Yes	Yes	Yes	Yes	Yes
8.	No?	Yes	Yes	Yes	Yes	Yes
9.	Yes	Yes	Yes	Yes	Yes	Yes
10.	Yes	Yes	Yes	Yes	Yes	Yes
11.	Yes?	Yes?	Yes?	Yes?	Yes	No
13.	Yes	No	Yes	Yes	Yes	Yes
14.	Yes	Yes	Yes	Yes	Yes	Yes
15.	No?	Yes	Yes	Yes	Yes	Yes
16.	Yes	Yes	Yes	Yes	Yes	Yes
17.	Yes	Combined			No	Yes
18.	Yes	Yes	Yes	Yes	Yes	Yes
19.	Yes	Yes	Yes	Yes	Yes	Yes
20.	Yes	Yes	Yes	Yes	Yes	Yes
21.	Yes	Yes	Yes	Yes	Yes	Yes
22.	Yes?	Yes	Yes	No	Yes	No
23.	Yes?	Yes	Yes?	Yes?	Yes	Yes
24.	Yes	Yes	Yes	Yes	Yes	Yes
25.	Yes	Yes	Yes	Yes	Yes	No
26.	Yes	Yes	Yes	Yes	Yes	Yes
27.	Yes	Yes?	Yes	Yes	Yes	Yes
28.	Yes	Yes	Yes	Yes	Yes	Yes
29.	No	No	No	No	Yes	Yes
30.	Yes	Yes	Yes	Yes	Yes	Yes
31.	Yes	Yes	Yes	Yes	Yes	No
32.	Yes	Yes	Yes	Yes	Yes	Yes
33.	Yes	Yes	Yes	Yes	Yes	Yes
34.	Yes	Yes	Yes	Yes	Yes	Yes
35.	Yes	Yes	Yes	Yes	Yes	Yes

The relative number of plates taken plus the deep and superficial treatments given in the various departments during the fiscal year (1932-1933) may be of interest. The total number of plates taken varies from 1,014 to 27,025. Ten reported over 5,000 plates taken; only five reported over 10,000. Ten reported under 3,000. Twenty-one departments reported that they gave superficial x-ray treatments, the number varying from 4 to 478. Only two gave over 100 superficial treatments. Only thirteen reported that they gave deep treatments, only four gave more than 100 such treatments during the year.

LABORATORIES AND PATHOLOGIC DEPARTMENTS*

The section of the questionnaire dealing with hospital laboratories and pathologic departments was detailed enough to give a fairly accurate impression of the relative efficiencies of these laboratories. Only one detail of the questionnaire aside from those apparent on the chart will be reported here; this concerns the percentage of necropsies secured.

Twenty-nine hospitals replied to this section of the questionnaire. Among the twenty-nine, seventeen reported better than a 50 per cent average for necropsies. Ten averaged 60 per cent or better; nine, 70 per cent or better and three, 80 per cent or better. One reported 90 per cent; another 96 per cent. The two latter figures represent an unusually high percentage for any hospital.

Only three hospitals reported less than 40 per cent necropsies.

These figures indicate that the pathologic departments of most of the children's hospitals are aware of the value of securing necropsies upon all deaths and make particular efforts to secure them.

LABORATORY AND PATHOLOGIC QUALIFICATIONS

Each questionnaire was graded according to the apparent qualifications of the persons in charge of the departments of pathology, bacteriology, chemistry and clinical pathology; on the equipment available, not only for routine work, but also for experimental studies; on the percentage of necropsies secured; on the degree of association of the internes with laboratory and pathologic departments; and also on the variety of laboratory studies that seem to be included as part of routine work.

Starting with the hospitals that seemed to be most complete, the word "excellent" is used. Grading from this to "inadequate" there are included: very good, good, and fair.

The questionnaires fall into the following groups:

Excellent	3
Very good	2
Good	8
Fair	16
Inadequate	4

Questionnaires No. 10 and No. 21 are insufficiently filled out for grading.

Those grouped in the class "fair" would, on examination of the questionnaire alone, without reference to other questionnaires, seem to be well equipped for good work in most instances. However, on comparison with the qualifications of the hospitals included in the three upper groups, distinct inadequacies are revealed—among the latter are included: part-time pathologist, etc., insufficient equipment, lack of association of internes with laboratory work, etc.

COMMENT

Generally the hospitals concerned in this report seem well equipped to carry on work in physiotherapy which, of course, is a most important field of therapy when working among children. As previously noted twenty-four hospitals maintain a separate department of physiotherapy; fifteen of these have full-time directors and twenty-three full-time technicians. The committee feels that a physiotherapy department, if its work is to be handled efficiently, must have at least one experienced, well-trained, full-time worker. Practically all forms of treatment listed in this chart should be available.

*We are indebted for this criticism to Dr. C. W. Apfelbach, pathologist of the Presbyterian Hospital, Chicago, Ill.

Diet kitchens in each hospital are apparently in charge of well-trained, experienced dietitians. This situation is commendable, for in these institutions proper food plays a large part in expediting recovery.

Twenty hospitals report that the staff physicians and dietitians cooperate in the supervision of standard special diets. Among the others either the dietitian alone or physician alone supervises the diet. We believe the first plan to be much more effective.

Relatively few of the hospitals (eight) have a dietitian assigned to the dispensary alone. In many instances the dispensary attendance is not large enough to warrant the full-time service of a dietitian. Among these the dietitian serves as she is needed in the dispensary.

In no dispensary is dieting advice available to other than dispensary patients. Only one reports this service available to the community at large.

Occupational therapy should be available in every hospital in which there are convalescents, unless that activity is provided in an associated convalescent home. Only four hospitals indicate that they maintain convalescent homes, twenty provide facilities for occupational therapy. These figures suggest that there are several institutions which might be improved in this respect. In twelve instances the department of occupational therapy is apparently very excellently organized, well equipped, and competently directed, as it should be in every hospital in which there is an appreciable number of convalescents, no matter whether their stay is to be long or short.

Schooling should be provided for convalescents in all hospitals if they are to be invalids for any length of time. Six provide this instruction only in their convalescent home. Six do not afford this advantage to convalescents. Commendably, public school systems cooperate and provide full-time teachers in eighteen instances, and five hospitals consider this work to be important enough to employ private teachers.

Play activities among the patients of twenty-eight hospitals are for the most part well cared for, eleven hospitals assigning special teachers and, in some instances, trained playground teachers do the work. Among a few institutions this work is carried on by volunteer workers and may or may not be satisfactory in these instances according to the ability of the volunteer.

X-ray departments in all of the hospitals seem efficient although four state that their department is inadequate. The number of treatments given in most of the institutions is relatively small when compared to figures from a similar-sized hospital which is primarily used for adults. This fact, of course, does not indicate that the children's hospitals are negligent in giving x-ray treatments, rather that conditions indicating treatment by x-ray are more common among adults.

If our grading of the pathologic, serologic, chemical and bacteriologic laboratories of the various hospitals has not been too severe there seems to be considerable room for improvement there. Only 39.3 per cent of these laboratories were able to achieve a rating of good, very good, or excellent and only 9 per cent excellent. Sixty and six-tenths per cent were rated as fair or inadequate, but only 12.1 per cent could be classified as inadequate.

In most instances the laboratory departments seem aware of their deficiencies and are making definite efforts to correct them.

Academy News

New Connecticut members of the American Academy of Pediatrics elected at the recent meetings in Cleveland are:

Dr. Edwin D. Weldon, Bridgeport
Dr. Cole B. Gibson, Meriden
Dr. Alfred C. Henderson, Stamford
Dr. Arthur A. Tower, Meriden
Dr. Robert T. Rogers, Greenwich
Dr. David Gaberman, Hartford

The addition of these six new members increases the membership in the state from eight to fourteen.

Dr. Edward J. Wynkoop, Syracuse, N. Y., has been appointed Cochairman for the Academy in New York.

Dr. Michael S. Picard, Shreveport, La., a member of the Academy, died suddenly last December.

Report From Nebraska

Pediatric activity in Nebraska has gradually assumed direction during the past year. The pediatrists have initiated or participated in the following projects:

1. Conference on Child Health. The medical program was as follows:

General Survey of Pediatrics in Nebraska
Clyde Moore, Omaha
Nutritional Problems
Howard B. Hamilton, Omaha
The Handicapped Child
William O. Colburn, Lincoln
School Health Program
Ernest W. Hancock, Lincoln
Tuberculosis
John H. Murphy, Omaha
The Problem Child
Herman M. Jahr, Omaha
Maternity Problems
Palmer Findley, Omaha
Maternal Mortality in Nebraska
Earl C. Sage, Omaha
Prenatal Care
Harold S. Morgan, Lincoln
Lowered Birth Rate
Harry E. Harvey, Lincoln

2. Through the efforts of the Nebraska Pediatric Society one year ago, a committee was organized to act as a central advisory body for all matters relating to

health problems of the preschool and school children. This committee is known as the advisory council of the School Health Officer of Omaha. It has the following personnel:

Clyde Moore, M.D., Chairman—American Academy of Pediatrics
H. A. Merchant, D.D.S., Secretary—Omaha District Dental Society
James W. Martin, M.D., Orthopedist, Omaha, Douglas County Medical Society
Charles M. Schwab, M.D., Eye Section, Douglas County Medical Society
Mrs. C. W. Pollard, League of Women Voters
Grace W. Pinkney, Superintendent of Nurses, Omaha Public Schools
E. T. Manning, M.D., Director of Health, Omaha Public Schools
Dr. H. W. Anderson, Superintendent, Omaha Public Schools
Jeannette Newlean, Omaha Elementary School Principal
Mrs. Charles Synder, Omaha P. T. A.
Mrs. Percy Powell, Council P. T. A.
Herman Jahr, M.D., Secretary, Omaha, Douglas County Medical Society
Claude T. Uren, M.D., Ear, Nose, and Throat, Douglas County Medical Society
A. E. Bennett, M.D., Psychiatry
H. B. Hamilton, M.D., Chairman, Pediatric Department, University of Nebraska
Floyd S. Clark, M.D., Chairman, Pediatric Department, Creighton University
J. C. Tighe, D.D.S., P. T. A., Parochial Schools
Mrs. Elizabeth Riner, Director, Home Making, Vocational Department
Miss Catherine Carrick, Supervisor of Health Education, Omaha Public Schools
Dr. W. H. Thompson, Professor Psychology, Municipal University
Mrs. J. J. Keegan, President, Women's Auxiliary, Douglas County Medical Society
Mrs. Lowell Dunn, Council of Social Agencies
Dr. Thomas Gardiner, Children's Section, District Dental Society
Miss Leeta Holdredge, Executive Director, V.N.A.
Mrs. George Neuhaus, Exofficio Women's Auxiliary
Mrs. Fred Whitecomb, Member-at-large

This committee meets regularly once a month. So far it has organized a definite plan for preschool examinations. All children of the economic level admitting them to the dispensaries are cared for by special clinics organized at the University of Nebraska and Creighton dispensaries. These clinics are manned entirely by pediatrists. Each child is given a careful examination by the physician in a private room, in the same manner as he would make an examination of a private patient. If in his opinion any special examination or treatment is needed, the child is referred to that department of the regular dispensary. Children whose parents can afford to pay a fee for examination are referred to the family physician. Earnest work by the various P. T. A. organizations has made this plan very satisfactory to both the P. T. A. and the medical profession.

3. Survey of hearing among school children. An audiometer has been purchased and, starting in September, a complete survey will be made of all of the school children. This will be under the general supervision of Dr. Uren.

4. Organization of a nutrition clinic. This clinic will be a permanent clinic under the charge of Dr. Herman Jahr. The following is the general plan of its organization:

I. Scope of the Project
  A. All elementary schools—public and parochial
  B. All preschool children
    1. In families with school children, to be reached through the schools (now being done)

2. In families with no school children, to be reached through social agencies and general publicity. Children to be brought to the nearest school for inspection and examination on the appointed dates (long range plan).

C. All high school pupils (long range plan)

II. Personnel

A. Physicians, dentists, school nurses

B. Teachers and principals in an advisory capacity and P. T. A.

C. Cooperating agencies. Relief cases should be registered with Social Service Exchange in order to find out what relief agency is handling the case so that what follow-up work has to be done will be by the agency already going to the home.

1. P. T. A.
2. Dispensaries—medical and dental
3. Relief agencies, such as P. W. A., F. E. R. A., J. W. F., Catholic Charities, County Charities, Council of Social Agencies, Nebraska Nutrition Council
4. Medical and dental auxiliaries

III. Procedure

A. Finding the cases

1. School children. Doctors, dentists, and nurses screen each school according to standards to be set up by the local medical and dental societies (standards appended).
2. Inspection of preschool child brought into the school

B. Examinations of children

1. Medical
2. Dental
3. Use of uniform examination blank suggested by the personnel staff
4. Psychologic—examination for mental level, emotional stability, and motor coordination

C. Corrections

1. Physical defects
   a. Nonrelief cases by family physician and dentist
   b. Relief cases
      (1) Private physician and dentist
      (2) Dispensaries—medical and dental
2. Dietary deficiencies
   a. Home follow-up. Nutrition institute by Nutrition Council. Divide responsibility between different relief agencies, V. N. A., social worker, or person already going to the home. Persons in direct contact are school nurses.
   b. Relief agencies on the individual case. School nurses, V. N. A., and social agencies
3. Mental defects and emotional instabilities
   a. A clinical set-up for the giving of examinations and study of deficiencies
   b. School follow-up
   c. Home follow-up

IV. Comments

A. (Important.) Committees necessary for the project—General chairman, preschool chairman (P. T. A. pres.), school child chairman, volunteer motor corps, registrars, case workers

B. Probable number of children to be inspected and examined. (Varies with facilities. All plans point to the necessity of a central county clinic.) The school children will be examined at the County Hospital; follow-up work to be delegated to social agencies.

In addition to the above projects the council considers and advises in regard to various problems brought to its attention by the health director of the schools such as school lunches, school athletics health education program, immunization program, etc. The chief value in having such a committee is the centralizing of all pediatric activities in a body representing all phases of child welfare.

CLYDE H. MOORE,
State Chairman.

Report From New Jersey

A report on child health work in New Jersey was presented at the Regional Conference of the American Academy of Pediatrics in November, 1933. This report has been printed in *Medical Record* for April 18, 1934.

STANLEY J. NICHOLS,
State Chairman.

Report From Wisconsin

The preliminary figures of the scarlet fever immunization program as carried out jointly by the Milwaukee Health Department and the Milwaukee County Medical Society will soon be available.

When scarlet fever reached excessive epidemic proportions in the spring, Dr. J. P. Koehler, Director of the Milwaukee Health Department, appealed to the County Medical Society. The Child Welfare Committee of the Society approved an extensive immunization program in the infected school areas. Fifty physicians cooperated in the program.

The following figures give the results so far obtained:

Dick tests given	10,653
Positive Dick test	6,877
Negative Dick test	3,574

The following numbers received the usual series of Dick toxin doses:

1st. inj.	2nd inj.	3rd inj.	4th inj.	5th inj.	Total	6th inj.	7th inj.
5,026	4,459	3,884	3,132	2,760	19,261	738	65

The decreasing number receiving later doses reveals the numbers who did not return for completing the immunization. After immunization, 2,435 were again given the Dick test. Of these, there were 2,290 negative tests, 109 positive, 95.8 per cent negative.

It is interesting to note that only one case of scarlet fever developed in any child who had received as many as three doses of Dick toxin.

Reactions were recorded as follows:

Local reactions:	554	Light
	108	Moderate
	8	Severe
Systemic reactions:	273	Light
	152	Moderate
	7	Severe

A. B. SCHWARTZ,
State Chairman.

Report From Iowa

The present set-up in Iowa in its child health activities is centered in a committee of the State Medical Society appointed by the House of Delegates and closely associated with the Council. This committee was appointed three years ago at the request of the State Pediatric Society and has been continued up to date. It is designated as the Committee on Child Health and Protection and has the following membership: Fred Moore, Chairman; J. D. Boyd, Pediatrician, Iowa State University; E. D. Plass, Obstetrician, State University; H. E. Farnsworth, General Practitioner, Storm Lake; and the Chairman of the State Academy Committee. It is apparent, therefore, that child health projects, in this state, from the viewpoint of medical participation, are carried on through the channels of organized medicine, which, it is believed, is of considerable importance in the attainment of desirable objectives such as the Academy stands for.

A report of Iowa activities resolves itself, therefore, into a report of the activities of this committee. These are divisible into three subgroups: first, cooperation with the State Department of Health; second, cooperation with the program committee of the state society; third, cooperation with the Speakers' Bureau of the State Pediatric Society.

1. Cooperation with the State Department of Health.

This the committee feels is unquestionably its most important function. An amiable workable program, which has been of mutual benefit to organized medicine and the Health Department, was early effected. Perhaps the outstanding accomplishment of the Committee up to date has been the development of a plan in conjunction with the Health Department which aims to have health projects in the various counties of the state participated in and controlled by the local medical organization. On behalf of the committee, the Secretary of the state society sent a special letter to each county secretary urging appointment of a local committee which might be called the County Society's Committee on Child Health and Protection. The plan so far functions chiefly in relation to immunization programs, but its further possibilities are readily apparent. Requests to the Health Department, or to the State Medical Office, from nonmedical sources for the putting on of immunization campaigns are referred to the county society's committee—with the notation that the Health Department can cooperate only after the county society's approval has been secured. From various reports received it can be said that the plan has been most satisfactory to the Health Department, to the physicians in the state, and to the lay groups. As evidence of the latter it might be interesting to note that the Farm Bureau organization sent announcements of the plan to sixteen hundred township chairmen in the state.

Another task which the committee has performed at the request of the Health Department has been to review all the publications which the Bureau of Maternal and Child Hygiene has for distribution. Forty-three pieces of literature, varying from leaflets to pamphlets of from forty to fifty pages, were carefully read by each member of the committee and their criticisms recorded. The criticisms were grouped together and again reviewed by the committee, after which each member recorded his opinion as to how the literature was to be distributed; that is, whether it should be sent to anyone upon request, upon request of a physician only, or whether it should not be distributed at all in present form. One of the important pieces of literature was the consent slip used in immunizing campaigns. The committee was quite unanimous in recommending that this be changed so that a choice between private physician and group immunization could be indicated, and in either choice the right of the physician to compensation was recognized. It was the opinion of the committee to stress the idea of immunization by the private physician by the child's first birthday. Finally the committee met as a whole with

the officials of the Bureau of Maternity and Child Health in a half-day session, the result of which was an exchange of ideas extremely beneficial to both groups.

2. Cooperation with the Program Committee of the State Medical Society.

Last year, and the year before, at the annual meeting of the State Medical Society the committee was given the privilege of arranging a pediatric program for a half day of the three-day session. This year the meeting is to be divided into sections, with pediatric sessions being held on two of the afternoons. The committee has planned a number of short clinical presentations much after the manner of the central states' program. Whether or not this is the best method of presenting pediatric subjects at a state meeting may be questioned, but in all fairness it must be said that so far many favorable comments have been received.

3. Cooperation with the Speakers' Bureau of the state society.

Education of the general practitioner and of lay audiences through activities of the speakers' bureau has been carried on in Iowa in a most satisfactory manner. A teaching course of ten lectures was put on by the state university in several cities during the last year. Pediatrics, obstetrics, and medicine, were the subjects presented.

The pediatricians of the State Pediatric Society have been used freely in addressing county society meetings, parent-teachers' organizations, and for radio addresses.

The committee has discussed somewhat the desirability of organizing "teams" for pediatric teaching, such as the Illinois group has done, but up to the present no action has been taken.

In addition to the activities of the Committee on Child Health and Protection enumerated above, the State Academy Committee has interested itself in attempting to increase the Academy membership in the state. At present Iowa has nine members, with two more applications already presented. There are possibly twenty men in all in Iowa who should be Academy members. With the reduced initiation fee and with improved business conditions, it is hoped that all the qualified men of the state may become affiliated with the national organization in the near future.

As to suggestions concerning the activities of the Academy I should like to bring up the matter of meeting time of the annual session of the Academy. Eventually I hope this session may be held at a different time than the A. M. A. It seems to me that it would add considerably to the prestige of the organization in the eyes of the rank and file of the pediatricians throughout the country if it were dignified with an annual session of its own such as is held by the other specialties.

LEE F. HILL,
State Chairman.

News and Notes

On Friday and Saturday, October 19 and 20, there will be a Region I meeting in New York, conducted jointly by the Academy, the New England Pediatric Society, the Philadelphia Pediatric Society, and the Section of Pediatrics of the Academy of Medicine in New York City. The meeting will be chiefly clinic in nature and the headquarters are at the Ambassador Hotel, Fifty-First Street and Park Avenue, New York.

At the meeting of **The American Board of Pediatrics** held June 9 and 10 in Cleveland, the following applicants were certified.

Group I

I. A. Abt, Chicago
C. A. Aldrich, Winnetka
N. N. Allen, Houston
Samuel Amberg, Rochester, Minn.
L. O. Ashton, New York City
P. S. Astrowe, Kansas City
O. L. Baldwin, Columbus, O.
O. Barbour, Peoria
P. F. Barbour, Louisville
E. J. Barnett, Spokane
G. E. Baxter, Chicago
P. W. Beaven, Rochester, N. Y.
Wm. W. Belford, San Diego
N. C. Bender, Buffalo
P. B. Bender, Philadelphia
B. Bernbaum, Detroit
Robt. Blessing, Evanston
C. E. Boynton, Atlanta
W. N. Bradley, Philadelphia
J. W. Bruce, Louisville
W. P. Buffum, Providence
H. C. Carpenter, Philadelphia
J. C. Carter, Indianapolis
H. Casparis, Nashville
L. I. Clark, Toledo
W. E. Collins, Kalamazoo
E. P. Cook, San Jose
T. B. Cooley, Detroit
F. J. Corper, Chicago
W. C. Davison, Durham
H. P. Dawson, Montgomery
A. G. DeSanctis, New York City
H. F. Downing, Cincinnati
J. Dunn, Davenport
J. I. Durand, Seattle
H. W. Elghammer, Chicago
M. M. Eliot, New Haven
H. K. Faber, San Francisco
E. S. Fish, Los Angeles
R. G. Flood, San Francisco
R. P. Forbes, Denver
J. M. Frawley, Fresno
E. Friedman, Boston
F. P. Gengenbach, Denver
S. D. Giffen, Toledo
O. L. Goehle, Lakewood, O.
S. Goldberg, Philadelphia
T. D. Gordon, Grand Rapids
J. V. Greenebaum, Cincinnati
S. McC. Hamill, Philadelphia
H. H. Harrison, Asheville
W. M. Hartshorn, New York City
C. Harvey, Pontiac
J. E. Harvey, Pasadena
H. F. Helmholz, Rochester, Minn.
T. C. Hempelmann, St. Louis
S. C. Henn, Chicago
J. A. Henske, Omaha
Chas. Herrman, New York City
H. L. Higgins, Boston
L. F. Hill, Des Moines
E. G. Hummel, Camden
F. E. Johnson, New York City
A. D. Kaiser, Rochester, N. Y.
S. R. Kaliski, San Antonio
S. Karelitz, New York City
R. L. J. Kennedy, Rochester, Minn.
C. G. Kerley, New York City
Le Grand Kerr, Brooklyn
R. A. Knox, Washington, Pa.
Benj. Kramer, Brooklyn
F. I. Krauss, Chatham
G. N. Krost, Chicago
J. S. Leopold, New York City
S. Z. Levine, New York City
D. J. Levy, Detroit
J. I. Linde, New Haven
J. G. Logue, Williamsport
H. Lowenburg, Philadelphia
R. T. Lucas, Shreveport
W. P. Lucas, San Francisco
H. O. Lussky, Evanston
C. P. Mangum, Richmond
C. W. Martin, Far Rockaway, N. Y.

D. D. Martin, Tampa
E. W. May, Detroit
K. M. Mayer, Chicago
J. Meyer, Birmingham
E. C. Mitchell, Memphis
J. C. Montgomery, Detroit
E. E. Moody, Los Angeles
H. L. Moore, Dallas
J. L. Morse, Boston
G. F. Munns, Winnetka
J. E. McClelland, Cleveland
A. L. Newcomb, Chicago
S. Nichols, Asbury Park
P. Nicholson, Ardmore
Jos. Palma, Honolulu, T. H.
A. H. Parmelee, Oak Park
M. G. Peterman, Milwaukee
E. S. Platou, Minneapolis
R. M. Pollitzer, Greenville, S. C.
P. S. Potter, Berkeley
C. M. Pounders, Oklahoma City
H. B. Pryor, San Francisco
Boyd Reading, Galveston
J. L. Reichert, Chicago
O. Reiss, Los Angeles
R. K. Rewalt, Williamsport
A. L. Richardson, Detroit
F. G. Riley, Meridian, Miss.
M. H. Roberts, Atlanta
E. E. Rodenheiser, Upper Darby, Pa.
E. H. Rohlfing, St. Louis
F. C. Rodda, Minneapolis
P. Rosenblum, Chicago
J. W. Rosenfeld, Portland
L. T. Royster, University, Pa.
John Ruhräh, Baltimore
L. W. Sauer, Evanston
F. W. Schultz, Chicago
E. H. Schorer, Kansas City
L. C. Schroeder, New York City
E. G. Schwarz, Fort Worth
H. Schwarz, New York City
A. J. Scott, Jr., Los Angeles
R. G. Sharp, San Diego
E. B. Shaw, San Francisco
A. A. Shawkey, Charleston, W. Va.
J. Signorelli, New Orleans
J. F. Sinclair, Philadelphia
A. de G. Smith, Washington, D. C.
R. M. Smith, Boston
T. C. Smith, Louisville
V. W. Spickard, Seattle
W. C. A. Steffen, Flushing
J. L. Stein, Brooklyn
W. B. Stewart, Atlantic City
P. M. Stimson, New York City
V. E. Stork, Los Angeles
H. C. Stuart, Boston
J. M. Sturtevant, New York City
H. E. Thelander, San Francisco
A. J. Thornton, San Diego
O. N. Torian, Indianapolis
I. H. Tumpeer, Chicago
R. M. Tyson, Philadelphia
P. Van Ingen, New York City
B. S. Veeder, St. Louis
J. R. Vonachen, Peoria
P. C. Waldo, Oak Park
A. A. Walker, Birmingham
J. H. Wallace, Oak Park
T. M. Watson, Greenville, N. C.
E. S. Wegner, Lincoln
P. J. White, St. Louis
S. J. Wilson, Brooklyn
G. H. Woltereck, Baltimore
C. W. Wyckoff, Cleveland
Jos. Yampolsky, Atlanta
G. E. Zimmerman, Sioux Falls

Group II

P. S. Barba, Philadelphia
I. R. Cohn, Toledo
E. E. Martmer, Detroit
L. T. Meiks, Indianapolis
G. R. Murphy, Elmira
J. F. Sander, Lansing
J. C. Williams, Philadelphia

Group III

R. W. Holt, Niagara Falls
J. F. Miller, Newark
A. R. Nelson, Grand Rapids

At the annual meeting of the Society for Pediatric Research held at Atlantic City, April 29, the following officers were elected for next year: Dr. Joseph Stokes, Jr., Philadelphia, President; and Dr. A. A. Weech, 630 West 168th Street, New York City, Secretary-treasurer. The next meeting will be held in Atlantic City on April 30, 1935.

A combined meeting of the New England Pediatric Society, Connecticut members of the American Academy of Pediatrics and Hezekiah Beardsley Club (an association of Connecticut pediatricians) was held on May 19, 1934, in New Haven. A

clinical session was held at the New Haven Hospital in the afternoon. About fifty members of these three societies attended a dinner in the auditorium of the New Haven Medical Society Building. Dr. Joseph I. Linde of New Haven, vice-president of the New England Society, introduced the President, Dr. James Gamble of Boston, and Dr. Louis C. Schroeder, Chairman of Region I of the American Academy of Pediatrics, who was the guest of honor. Dr. Schroeder spoke on the subject of the American Academy of Pediatrics.

Book Review

Child Guidance Clinics, a Quarter Century of Development. GEORGE S. STEVENSON, M.D., AND GEDDES SMITH, The Commonwealth Fund, New York, 1934, pp. 186.

This summary of the history and development of the "child guidance clinic" with a discussion of its present form and trends is of considerable interest and should be read by pediatricians. Although it is written by individuals who have been closely associated with the development of clinics, the status of the clinic, its weaknesses as well as its strength, is discussed in a broad, impartial manner. The changing goal and aims of the clinic, as well as the changes in the methods of approach and study of patients, which have developed during the quarter century are thoroughly discussed and, we might add, are typical of the underlying changes in all fields of medical organization. The present trend to integrate the child guidance clinic into the university and medical school curriculum is, we feel, the most important step in the child guidance movement that has been made. One of the chief faults of the clinic has been due to its being regarded as a social agency rather than a medical institution. In the opinion of the reviewer, the authors have somewhat misunderstood the pediatric viewpoint. Pediatrics questions the place the so-called "clinical psychologist" has attempted to assume. Pediatrics has no quarrel with psychiatry and the child guidance clinic. In fact, one gleans from this book that pediatrics is asking more of the child guidance clinic than the clinic is prepared to give at the present time.

The authors clearly state that the child guidance clinic can and only should care for a minor fraction of children needing guidance. The only solution seems to be that the joint efforts of psychiatric and pediatric departments in our medical schools must be directed to instruction along child guidance lines. The reviewer feels that too much stress has been placed upon the relation of the child guidance clinic to social agencies rather than upon the family unit, although this may have been necessary in the early days of its development. The authors admit the difficulty of proving end-results of child guidance clinic methods. This is a necessity before the importance of the clinic and its limitations can be definitely decided, and the most important problem before the leaders in the child guidance clinic movement is an appraisal of their work. One infers from the book that sufficient uniformity of set-up and methods now exists to make an appraisal possible. The reviewer is of the opinion that the child guidance clinic methods have been successful and of value. The book is a fair and timely discussion of one of the methods that has been evolved in recent years to deal with an important phase of child hygiene and merits a widespread reading by pediatricians.

B. S. V.

Comments

FOR SOME time a subcommittee of the Council on Medical Education of the American Medical Association and a subcommittee of the Advisory Board for Medical Specialties have been working out certain essentials of organization and basic qualifications which were adopted by each group at Cleveland in June. A special examining board must be organized in the manner outlined and must adopt these basic qualifications to become a member of the National Advisory Board, and in turn to be approved and have its certificates recognized by the Council on Medical Education of the A. M. A. The A. M. A. will recognize as specialists only those who hold the certificate of the particular specialty examining board. It has been agreed that at present only twelve fields are to be recognized as suitable for certification. In seven of these fields boards are already organized and issuing certificates.

The basic qualifications are important, as they increase the amount of training necessary for certification over the minimum requirements now in existence in the rules of most of the boards. The educational requirements are briefly as follows:

1. Graduation from an approved medical school
2. Completion of an interneship of not less than a year in an approved hospital.
3. Special training (to be effective not later than Jan. 1, 1938).

A period of study after the interneship of not less than three calendar years in clinics, dispensaries, hospitals, or laboratories competent to provide a satisfactory training in the special field. This period shall include:

a. Intensive graduate training in the basic medical sciences necessary to the proper understanding of the disorders and treatment involved in the specialty in question.

b. An active experience of not less than eighteen months in hospitals, clinics and dispensaries, or diagnostic laboratories recognized as competent in the specialty.

c. Examination in the basic medical sciences, as well as in the clinical laboratory and public health aspects.

4. An additional period of not less than two years of practice.

What has been accomplished is this: The specialty examining boards belonging to the National Advisory Board for Medical Specialties, as the American Board of Pediatrics, are now formally recognized by the American Medical Association through its Council on Medical Education. A general plan for the control and development of specialization and specialists in the United States has been formulated. The certification and recognition of specialists has been placed on an educational basis. The certificate from a specialty qualifying board is now of actual value rather than potential.

Quite obviously the scope of work of the American Board of Pediatrics has been enlarged by these regulations. Not only must it conduct the examinations, but it must determine and outline the training in basic medical sciences, now a part of the qualifications. Second, it must pass upon the pediatric hospitals, clinics, and dispensaries to determine if such institutions are giving satisfactory training. The mere fact that a young physician serves two years in a hospital for children does not necessarily mean that the training received there is satisfactory, and a

list of "approved" hospitals and pediatric centers must be developed. At the present time the standards for issuing certificates in pediatrics remain as outlined several months ago. It is obvious that these requirements and qualifications must be revised within the next year or so.

The period of training required for specialization outlined above has been criticized by some as unnecessarily long for certain specialties. It amounts to six years of training after graduation. While such a period is obviously necessary for some specialties, as surgery, such a period of training has not so far been considered necessary for pediatrics. An interesting side light which is of importance in connection with this point was the failing of 50 per cent of the six applicants in Group III at the first examination given by the Board in Cleveland in June.

It is of interest to note that this method for the control of specialization, which has been adopted by the A. M. A., is the method the Committee on Medical Education of the Academy advised in their report two year ago, after a complete study of the subject as related to the field of pediatrics. Each special group within itself controls the examination and certification.